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LUNAR ORBITER PHOTO SITE ACCURACY ANALYSIS ERROR ANALYSIS

(D2-100814-3)

By John P. Dyer

Prepared under Contract No. NAS1-7954 by
THE BOEING COMPANY
Seattle, Wash.

for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

REV LTR A

THE BOEING COMPANY

CODE IDENT. NO. 81205

NUMBER D2-100814-3

TITLE: Lunar Orbiter Photo Site Accuracy Analysis

Final Report - Error Analysis

ORIGINAL RELEASE DATE_____. FOR THE RELEASE DATE OF SUBSEQUENT REVISIONS, SEE THE REVISIONS SHEET. FOR LIMITATIONS IMPOSED ON THE DISTRIBUTION AND USE OF INFORMATION CONTAINED IN THIS DOCUMENT, SEE THE LIMITATIONS SHEET.

MODEL 939 CONTRACT NAS 1-7954

ISSUE NO._____ ISSUED TO: _____

PREPARED BY John P Dyer
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		SHEET NUMBER	REV LTR	SHEET NUMBER	REV LTR			SHEET NUMBER	REV LTR	SHEET NUMBER	REV LTR
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REVISIONS

LTR	DESCRIPTION	DATE	APPROVAL
A	Revision A is the first version of this document to be released. Page 17 was revised in accord with comments received from NASA review at Langley Research Center. The revision is for correction and clarification.		W.R. Burr 2/5/69 Supervised by: W. R. Burr L.B. Eldrenkamp 2/5/69 Approved by: L. B. Eldrenkamp for J.C. Graves 2/5/69 J. C. Graves Program Manager'

ABSTRACT

A selenographic error analysis was performed for representative photographs taken on all five Lunar Orbiter missions. Nine points within each photograph are analyzed; contributions to the total error are made by navigation, spacecraft attitude, camera on-time, and lunar radius errors.

KEY WORDS

Attitude
Camera-On-Time
Error
Latitude
Longitude
Moon-Radius
Navigation
One-Sigma
Photography
Telephoto
Wide-Angle

ACKNOWLEDGEMENT

The author is grateful to W. R. Burr and J. D. Harter for assistance in transcribing Error Analysis Results sheets, to G. D. Barrow for preparing Section 3.2.2, and to T. J. Hansen and M. L. Hurd for helpful suggestions. Capable programming assistance was given by S. D. Boerner, R. W. Myers, and D. VanZandt.

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PHOTO SITE ACCURACY ANALYSIS FINAL REPORT DOCUMENTS

TASK A - Photo Support Data

D2-100814-1 - Lunar Orbiter Photo Site Accuracy Analysis - Final Report - Photo Site Analysis

D2-100814-2 - Lunar Orbiter Photo Site Accuracy Analysis - Final Report - Supporting Data

D2-100814-3 - Lunar Orbiter Photo Site Accuracy Analysis - Final Report - Error Analysis

D2-100815-1 - Lunar Orbiter Improved Photo Supporting Data - Final Report - Lunar Orbiter I

D2-100815-2 - Lunar Orbiter Improved Photo Support Data - Final Report - Lunar Orbiter II

D2-100815-3 - Lunar Orbiter Improved Photo Supporting Data - Final Report - Lunar Orbiter III

D2-100815-4 - Lunar Orbiter Improved Photo Supporting Data - Final Report - Lunar Orbiter IV

D2-100815-5 - Lunar Orbiter Improved Photo Supporting Data - Final Report - Lunar Orbiter V

D2-100816-1 - Lunar Orbiter Simple Moon Residuals - Final Report

TASK B - Residual Feedback Study

D2-100818-1 - Application of Residual Feedback to Lunar Orbiter Residual Analysis - Final Report

TASK C - Tracking Data Residuals

D2-100817-1 - Lunar Orbiter Doppler Residual Study - Final Report

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1.0 SUMMARY

An error analysis was made for representative photo frames for the five missions. Selenographic latitude and longitude errors were determined for the camera axis intercept in the frame (point 0), corner points in the frame (EVAL border points 1, 12, 23, 34), and points approximately midway between the corners (EVAL border points 6, 17, 28, 39), for both the telephoto and wide-angle lenses. The associated eigenvalues (λ_1, λ_2), rotation angle (β), and correlation coefficient (ρ) for each frame point are also determined for the total error. Contributions to the total error are made by navigation, spacecraft attitude, camera on-time, and moon-radius errors, being errors in the nominal EVAL input parameters.

It should be emphasized that the errors in photo location and the overall error analysis described in this document do not account for uncertainties in the knowledge of the lunar gravitational model. Checkpoint analyses (described in TBC Document D2-100814-1) have shown that discrepancies in Apollo site locations of 1 - 2 km still remain after improvements are made in orbit determination procedures and spacecraft performance parameters. These discrepancies can be attributed, in a large degree, to uncertainties in the gravitational model.

For summarizing purposes, it is useful to consider the Error-Set Frames, frames typical of the error frames examined, giving representative and worst-case error analysis results. These results are included in this Section, being summarized and preceded by a concise Error Analysis Summary Table, giving a range of standard deviations for the total latitude and longitude errors. For Missions I, II, III, and V, it is seen that errors typical for Apollo frames are less than 0.4 km in latitude and longitude for the telephoto lens (T), and less than 0.6 km in latitude and longitude for the wide-angle lens (W). For some Apollo frames, larger errors are observed (a few km and more), due to a combination of factors including

- attitude error (due partially to large attitude maneuvers for some frames, in conjunction with increased altitude above 46 km for some frames, making the attitude error larger), and
- large camera axis tilt angle (making the error due to moon radius larger).

Generally speaking, for Missions I, II, III, and V, frames at low altitude (meaning 46 - 240 km), the total photo error variance is a combination of significant contributions from attitude and navigation sources, with a significant contribution

1.0 SUMMARY, cont'd

for some frame points due to moon radius error, especially for the W lens. For altitudes greater than approximately 240 km, the attitude error is the predominant contributor. Errors of a few km are not uncommon for Missions I, II, III, and V, as indicated in the Error Analysis Summary Table.

The photo errors due to camera on-time error are essentially negligible for all frames.

Frames taken at high altitude reflect the predominant attitude errors, with an increased attitude error for Mission IV frames where the maneuver is not made relative to celestial alignment, but to the previous attitude. The Error Analysis Summary Table indicates this trend for one, three, and five attitude maneuvers.

The Mission IV errors are large as the Summary Table indicates, being in the neighborhood of 30 km and more; nonlinearity is present in some of the larger errors ($>$ 90 km), but they are given as an indication of the extensive uncertainty of some frame points. In some cases the nominal or one or more perturbation intercepts (due to the 11 EVAL Program primary errors) for a frame point will be off the moon, permitting no data (ND) to be presented for that point.

In some cases the navigation errors used in this study are set equal to zero, due to unavailability of the errors; this is done with negligible error for Mission IV frames, where attitude errors predominate. For other missions, for low-altitude frames, the navigation errors used contribute a variance comparable to that for the attitude error for some points in the frame, and a negligible variance for other points.

Error Analysis Summary Table

One Sigma Surface Location, Kilometers

MISSION	FRAME	Note	SPACE-CRAFT ALTITUDE (KM)	CAMERA AXIS TILT ∠ (DEG)	Telephoto Lens		Wide-Angle Lens	
					σ_{LAT} (KM)	σ_{LONG} (KM)	σ_{LAT} (KM)	σ_{LONG} (KM)
I	42		261.2	16.5	.113-.940	.595-.677	.680-2.31	.569-1.11
	116	Large attitude maneuver	1454	4.9	3.95-7.42	.293-3.40	6.26-44.3	3.05-47.3
	137	Apollo Site	52.5	43.0	.185-.310	.435-.590	.132-.956	.306-1.34
	154	Typical of Apollo errors	49.2	5.0	.173-.224	.114-.131	.143-.405	.121-.238
	175	Apollo Site	48.5	19.4	.190-.325	.150-.169	.152-.533	.152-.375
II	22	Typical of Apollo errors	46.0	3.5	.203-.240	.107-.133	.171-.379	.109-.278
	134	Large attitude maneuver	1450	16.6	6.87-15.9	3.66-5.20	6.60-14.1	3.85-8.45
	162		45.8	69.5	1.02-2.58	.214-.317	.545-3.21	.228-1.24
III	37		393	5.1	1.09-1.16	3.72-4.14	1.16-2.22	4.20-6.64
	39		50.1	66.9	.212-4.44	.781-12.7	.143-.488	.391-1.60
	41		57.5	17.0	.184-.573	.157-.190	.0990-.633	.169-.379
	69	Typical of Apollo errors	47.6	7.0	.160-.193	.102-.122	.136-.382	.110-.260
	121	Large attitude maneuver	1461	12.6	6.60-11.6	3.08-4.65	7.40-10.6	3.30-6.43
	140	Apollo Site	46.4	37.6	.231-1.14	.607-3.45	.129-.519	.323-2.30
IV	6	One attitude maneuver	3508	2.7	8.80-16.4	9.03-177.	14.2-17.5	22.0-28.5
	14	Three attitude maneuvers	2746	0.3	16.8-22.2	10.4-14.5	16.3-179.	10.8-125.
	22	Five attitude maneuvers	2979	1.5	21.1-31.8	14.4-50.3	28.9-47.0	22.6-57.0
	75	Large attitude maneuver	6125	0.3	24.0-49.1	13.1-32.4	26.9	13.5
V	21	Large attitude maneuver	3343	17.0	3.57-30.1	15.2-80.0	5.55-19.2	18.4-80.3
	22	Large attitude maneuver	5107	10.1	3.92-34.2	23.5-113.	4.50-14.8	23.7-29.2
	32	Large attitude maneuver	1395	21.0	1.28-1.97	7.09-9.80	1.24-5.90	5.28-26.8
	38	Apollo Site; Large att.man.	98.0	59.2	.432-2.25	2.96-34.4	.407-2.64	1.92-7.24
	63	Large attitude maneuver	95.9	29.3	.351-.435	.293-.580	.344-.623	.202-1.34
	102	Large attitude maneuver	247.8	34.1	1.20-4.10	4.10-6.93	.740-26.6	2.56-35.5
	109	Apollo Site (Typical Apollo errors); Large att. man.	97.3	10.1	.248-.344	.240-.332	.232-.541	.222-.552
	130	Large attitude maneuver	233.5	7.1	.495-.760	.776-.945	.461-1.21	.824-1.59

ERROR SET FRAMES RESULTS

MISSION I FRAME 42

S/C ALTITUDE 261.2 KM
CAMERA TILT ∠ 16.5 °
ORBIT INCLINATION −11.5 °
S/C TRUE ANOMALY 332. °
μ CAMERA AXIS 4.3 °
λ CAMERA AXIS 31.9 °
μ NADIR 4.8 °
λ NADIR 34.4 °
NOTE:

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT *		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.0331° / 1.00 KM	.0203 / .615	.0372 / .113	.0224 / .677	.0390 / 1.18	.0209 / .633	.0762 / 2.31	.0368 / 1.11
NAVIGATION	.00292°	.00965°	.00275	.00971	.00292	.00965	.00234	.0108
ATTITUDE	.0330	.0172	.0369	.0194	.0389	.0179	.0756	.0328
CAMERA ON-TIME	.00232	.00176	.00026	.00178	.00032	.00176	.00010	.00198
MOON RADIUS	.00083	.00446	.00384	.00529	.00083	.00446	.00954	.0125

MISSION I FRAME 116

S/C ALTITUDE 1454. KM
CAMERA TILT ∠ 4.9 °
ORBIT INCLINATION −11.5 °
S/C TRUE ANOMALY 138. °
μ CAMERA AXIS −5.9 °
λ CAMERA AXIS 152. °
μ NADIR −7.5 °
λ NADIR 149. °
NOTE: R(180°) P(0°) Y(0°)

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.228° / 6.93 KM	.097 / 2.94	.266 / 8.09	.105 / 3.06	.253 / 7.66	.100 / 3.05	1.461 / 44.3	1.565 / 47.3
NAVIGATION	.00594°	.00110°	.00626	.00104	.00594	.00110	.0155	.0147
ATTITUDE	.220	.0970	.266	.105	.253	.100	1.460	1.563
CAMERA ON-TIME	.00020	.00106	.00031	.00111	.00021	.00106	.00353	.00642
MOON RADIUS	.00084	.00193	.00557	.00365	.00083	.00193	.0508	.0761

MISSION I FRAME 137

S/C ALTITUDE 52.5 KM
CAMERA TILT ∠ 43.0 °
ORBIT INCLINATION −11.5 °
S/C TRUE ANOMALY 346.8 °
μ CAMERA AXIS 1.5 °
λ CAMERA AXIS −19.8 °
μ NADIR 1.7 °
λ NADIR −18.2 °
NOTE: APOLLO FRAME

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.00727° / .220 KM	.0158 / .480	.0102 / .310	.0180 / .590	.00852 / .261	.0153 / .482	.0315 / .956	.0443 / 1.34
NAVIGATION	.00129°	.00634°	.00143	.00614	.00129	.00634	.00367	.00792
ATTITUDE	.00892	.00644	.00845	.00755	.00922	.00669	.0264	.0262
CAMERA ON-TIME	.00037	.00196	.00032	.00199	.00037	.00196	.00010	.00142
MOON RADIUS	.00177	.0128	.00551	.0150	.00177	.0128	.0168	.0356

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μ, LATITUDE; λ, LONGITUDE

* GIVING CONSERVATIVE ERRORS

△ KM ON MOON

ERROR SET FRAMES RESULTS

MISSION I FRAME 154

S/C ALTITUDE 49.2 KM
CAMERA TILT ∠ 5.0 °
ORBIT INCLINATION -11.5 °
S/C TRUE ANOMALY 351 °
μ CAMERA AXIS 0.7 °
λ CAMERA AXIS -36.5 °
μ NADIR 0.6 °
λ NADIR -36.4 °
NOTE: OF TYPICAL APOLLO ERRORS

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT *		CAMERA AXIS		EVAL BORDER POINT	
	$\sqrt{\mu}$	$\sqrt{\lambda}$	$\sqrt{\mu}$	$\sqrt{\lambda}$	$\sqrt{\mu}$	$\sqrt{\lambda}$	$\sqrt{\mu}$	$\sqrt{\lambda}$
TOTAL	.00611 ° / .185 KM	.00391 / .118	.00740 / .224	.00430 / .120	.00715 / .217	.00399 / .121	.0134 / .405	.00785 / .238
NAVIGATION	.00137 °	.00150 °	.00138	.00150	.00137	.00150	.00141	.00155
ATTITUDE	.00591	.00235	.00657	.00315	.00697	.00306	.0117	.00420
CAMERA ON-TIME	.00039	.00182	.00041	.00183	.00039	.00182	.00044	.00187
MOON RADIUS	.00065	.00100	.00309	.00172	.00065	.00100	.00632	.00618

MISSION I FRAME 175

S/C ALTITUDE 48.5 KM
CAMERA TILT ∠ 19.4 °
ORBIT INCLINATION -11.5 °
S/C TRUE ANOMALY 6.6 °
μ CAMERA AXIS -3.4 °
λ CAMERA AXIS -35.4 °
μ NADIR -2.9 °
λ NADIR -35.7 °
NOTE: APOLLO FRAME

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\sqrt{\mu}$	$\sqrt{\lambda}$	$\sqrt{\mu}$	$\sqrt{\lambda}$	$\sqrt{\mu}$	$\sqrt{\lambda}$	$\sqrt{\mu}$	$\sqrt{\lambda}$
TOTAL	.00753 ° / .269 KM	.00495 / .150	.0104 / .325	.00556 / .169	.00885 / .268	.00503 / .152	.0162 / .491	.0124 / .375
NAVIGATION	.00251 °	.00223 °	.00259	.00224	.00255	.00223	.00271	.00234
ATTITUDE	.00526	.00314	.00716	.00359	.00743	.00326	.00990	.00542
CAMERA ON-TIME	.00039	.00184	.00041	.00184	.00039	.00184	.00046	.00189
MOON RADIUS	.00405	.00252	.00791	.00309	.00405	.00252	.0123	.00956

MISSION ____ FRAME ____

S/C ALTITUDE KM
CAMERA TILT ∠ °
ORBIT INCLINATION °
S/C TRUE ANOMALY °
μ CAMERA AXIS °
λ CAMERA AXIS °
μ NADIR °
λ NADIR °
NOTE:

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\sqrt{\mu}$	$\sqrt{\lambda}$	$\sqrt{\mu}$	$\sqrt{\lambda}$	$\sqrt{\mu}$	$\sqrt{\lambda}$	$\sqrt{\mu}$	$\sqrt{\lambda}$
TOTAL	° / KM							
NAVIGATION								
ATTITUDE								
CAMERA ON-TIME								
MOON RADIUS								

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μ, LATITUDE; λ, LONGITUDE

* GIVING CONSERVATIVE ERRORS

4 KM ON MOON

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ERROR SET FRAMES RESULTS

MISSION II FRAME 22

S/C ALTITUDE 46.0 KM
CAMERA TILT ∠ 3.5 °
ORBIT INCLINATION -12. °
S/C TRUE ANOMALY 359. °
μ CAMERA AXIS 3.4 °
λ CAMERA AXIS 41.1 °
μ NADIR 3.4 °
λ NADIR 41.0 °
NOTE: TYPICAL OF APOLLO ERRORS

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT *		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.00695° / .211 KM	.00354 / .107	.00752 / .228	.00401 / .122	.00773 / .235	.00360 / .109	.0125 / .379	.00613 / .186
NAVIGATION	.00449	.00103	.00449	.00103	.00443	.00103	.00450	.00105
ATTITUDE	.00530	.00274	.00554	.00335	.00628	.00282	.0107	.00323
CAMERA ON-TIME	.00037	.00183	.00037	.00183	.00037	.00193	.00036	.00184
MOON RADIUS	.00015	.00079	.00234	.00066	.00015	.00079	.00455	.00476

MISSION II FRAME 34

S/C ALTITUDE 1450. KM
CAMERA TILT ∠ 16.6 °
ORBIT INCLINATION -12. °
S/C TRUE ANOMALY 138. °
μ CAMERA AXIS 5.0 °
λ CAMERA AXIS 174. °
μ NADIR -9.9 °
λ NADIR 172 °
NOTE: R(164°) Y(0°) P(0°)

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.289° / 8.75 KM	.124 / 3.74	.524 / 15.9	.172 / 5.20	.319 / 9.65	.127 / 3.85	.466 / 14.1	.279 / 8.45
NAVIGATION	.00600°	.00234	.00836	.00266	.00600	.00234	.00619	.00349
ATTITUDE	.288	.124	.523	.172	.319	.127	.466	.278
CAMERA ON-TIME	.00026	.00105	.00057	.00121	.00026	.00105	.00053	.00153
MOON RADIUS	.00806	.00090	.0188	.00484	.00806	.00090	.0100	.0140

MISSION II FRAME 162

S/C ALTITUDE 457.8 KM
CAMERA TILT ∠ 69.5 °
ORBIT INCLINATION -12. °
S/C TRUE ANOMALY 6.9 °
μ CAMERA AXIS 5.5 °
λ CAMERA AXIS -20.0 °
μ NADIR 1.0 °
λ NADIR -20.0 °
NOTE:

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.0783° / 2.41 KM	.00942 / .276	.0851 / 2.58	.00992 / .301	.0883 / 2.68	.00977 / .295	.106 / 3.21	.0411 / 1.24
NAVIGATION	.00201°	.00107	.00206	.00107	.00201	.00168	.00193	.00111
ATTITUDE	.0652	.00918	.0205	.00942	.0263	.00954	.0370	.0379
CAMERA ON-TIME	.00029	.00183	.00077	.00184	.00029	.00183	.00045	.00186
MOON RADIUS	.0445	.00089	.0477	.00224	.0445	.00089	.0418	.0157

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

μ, LATITUDE; λ, LONGITUDE

* GIVING CONSERVATIVE ERRORS
△ KM ON MOON

ERROR SET FRAMES RESULTS

MISSION III FRAME 37

S/C ALTITUDE 393. KM
CAMERA TILT ∠ 5.1 °
ORBIT INCLINATION -21. °
S/C TRUE ANOMALY 69. °
μ CAMERA AXIS -20.0 °
λ CAMERA AXIS 103. °
μ NADIR -19.4 °
λ NADIR 104. °
NOTE:

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT *		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.0367° 1.11 KM	.1240° 3.76	.0381° 1.16	.1367° 4.14	.0384° 1.16	.1439° 4.35	.0731° 2.22	.2191° 6.64
NAVIGATION	.00725°	.00249°	.00727	.00241	.00725	.00249	.00764	.00258
ATTITUDE	.0359	.124	.0373	.1366	.0378	.1439	.0722	.2189
CAMERA ON-TIME	.00025	.00162	.00029	.00156	.00025	.00162	.00043	.00154
MOON RADIUS	.00091	.00115	.00207	.00427	.00091	.00115	.00837	.00912

MISSION III FRAME 39

S/C ALTITUDE 50.1 KM
CAMERA TILT ∠ 66.9 °
ORBIT INCLINATION -21. °
S/C TRUE ANOMALY 356. °
μ CAMERA AXIS 0.4 °
λ CAMERA AXIS 25.2 °
μ NADIR 1.4 °
λ NADIR 29.3 °
NOTE: ~~R(-77) P(-55) Y(0°)~~

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.0148° .449 KM	.0495 1.50	.1465 4.44	.4181 12.7	.0161 .488	.0526 1.60	.00985 .298	.0299 .905
NAVIGATION	0 [b]	0	0	0	0	0	0	0
ATTITUDE	.0121°	.0320°	.1366	.387	.0136	.0366	.00720	.02217
CAMERA ON-TIME	.00057	.00217	.00134	.00771	.00057	.00217	.00071	.00191
MOON RADIUS	.00852	.0378	.0531	.1579	.00852	.0378	.00610	.0205

MISSION III FRAME 41

S/C ALTITUDE 57.5 KM
CAMERA TILT ∠ 17.0 °
ORBIT INCLINATION -21. °
S/C TRUE ANOMALY 349. °
μ CAMERA AXIS 3.4 °
λ CAMERA AXIS 20.1 °
μ NADIR 3.9 °
λ NADIR 20.3 °
NOTE:

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.00822° .249 KM	.00545° .165	.0187 .573	.00556 .168	.00926 .281	.00559 .169	.0209 .633	.0125 .379
NAVIGATION	0 [b]	0	0	0	0	0	0	0
ATTITUDE	.00728°	.00480°	.00859	.00477	.00859	.00495	.0190	.00734
CAMERA ON-TIME	.00063	.00175	.00081	.00175	.00063	.00175	.00057	.00183
MOON RADIUS	.00375	.00150	.00567	.00225	.00325	.00190	.00960	.00993

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

μ, LATITUDE; λ, LONGITUDE

* GIVING CONSERVATIVE ERRORS

[b] NOT AVAILABLE

[h] KM ON MOON

ERROR SET FRAMES RESULTS

MISSION III FRAME 69

S/C ALTITUDE 47.6 KM
CAMERA TILT ∠ 7.0 °
ORBIT INCLINATION −21 °
S/C TRUE ANOMALY 358. °
μ CAMERA AXIS 0.1 °
λ CAMERA AXIS 21.4 °
μ NADIR 0.3 °
λ NADIR 21.5 °
NOTE: TYPICAL OF ALL 69 ERRORS

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT *		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.00089° .184 KM ♮	.00352 .107	.00780 .237	.00401 .122	.00693 .211	.00364 .110	.0126 .382	.00861 .260
NAVIGATION	.00180°	.00048°	.00182	.00050	.00180	.00048	.00183	.00054
ATTITUDE	.00516	.00287	.00659	.00252	.00546	.00338	.0112	.00378
CAMERA ON-TIME	.00068	.00174	.00067	.00174	.00068	.00174	.00067	.00176
MOON RADIUS	.00151	.00072	.00369	.00221	.00151	.00072	.00533	.00252

MISSION III FRAME 121

S/C ALTITUDE 1461. KM
CAMERA TILT ∠ 12.6 °
ORBIT INCLINATION −21. °
S/C TRUE ANOMALY 139. °
μ CAMERA AXIS −24.0 °
λ CAMERA AXIS 127. °
μ NADIR −12.9 °
λ NADIR 127. °
NOTE: R(169°) Y(0°) P(0°)

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.253° 7.70 KM	.107 3.21	.384 11.6	.142 4.34	.280 8.50	.108 3.30	.351 10.64	.189 5.73
NAVIGATION	.00339°	.00357°	.00410	.00412	.00339	.00357	.00331	.00462
ATTITUDE	.253	.106	.384	.142	.280	.106	.351	.189
CAMERA ON-TIME	.00025	.00109	.00021	.00123	.00025	.00109	.00028	.00134
MOON RADIUS	.00568	.00098	.01311	.00233	.00568	.00098	.00445	.01152

MISSION III FRAME 140

S/C ALTITUDE 46.4 KM
CAMERA TILT ∠ 37.6 °
ORBIT INCLINATION −21. °
S/C TRUE ANOMALY 2.3 °
μ CAMERA AXIS −3.0 °
λ CAMERA AXIS −23.0 °
μ NADIR −1.9 °
λ NADIR −22.6 °
NOTE: APOLLO FRAME

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.0123° .372 KM	.0338 1.62	.0375 1.14	.1146 3.45	.0129 .390	.0350 1.06	.0107 .325	.0760 2.30
NAVIGATION	.00144	.00227	.00160	.00372	.00144	.00227	.00143	.00287
ATTITUDE	.00791	.01588	.02395	.06825	.00876	.01822	.01015	.05335
CAMERA ON-TIME	.00042	.00125	.00025	.00185	.00042	.00125	.00046	.00151
MOON RADIUS	.00728	.02986	.02400	.07055	.00822	.02998	.00956	.05392

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

ERROR SET FRAMES RESULTS

MISSION IV FRAME 6

S/C ALTITUDE 3508. KM
CAMERA TILT ∠ 2.7 °
ORBIT INCLINATION 85. °
S/C TRUE ANOMALY 287. °
μ CAMERA AXIS -71.8 °
λ CAMERA AXIS 93.3 °
μ NADIR -71.7 °
λ NADIR 76.3 °
NOTE: 1ST OF SERIES REGARDING ATTITUDE MANEUVERS

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT *		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.402 ° 12.6 KM	.674 20.4	.541 16.4	2.92 88.5	.468 14.2	.723 22.0	.579 17.5	.941 28.5
NAVIGATION	.00321	.00327	.00341	.00262	.00322	.00155	.00117	.00424
ATTITUDE	.402	.674	.541	2.92	.468	.723	.579	.941
CAMERA ON-TIME	.00092	.00007	.00105	.00749	.00096	.00007	.00003	.00144
MOON RADIUS	.00010	.00590	.00849	.0274	.00010	.00590	.01902	.01228

MISSION IV FRAME 14

S/C ALTITUDE 2746. KM
CAMERA TILT ∠ 0.3 °
ORBIT INCLINATION 85. °
S/C TRUE ANOMALY 345. °
μ CAMERA AXIS -14.0 °
λ CAMERA AXIS 89.6 °
μ NADIR -14.3 °
λ NADIR 89.2 °
NOTE: 3RD OF SERIES REGARDING ATTITUDE MANEUVERS

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.582 ° 17.6 KM	.342 10.4	.705 21.4	.436 13.2	.690 20.9	.355 10.8	5.91 179	1.10 33.3
NAVIGATION	.00317	.00259	.00335	.00071	.00317	.00259	.01451	.00316
ATTITUDE	.582	.342	.705	.436	.690	.355	5.91	1.10
CAMERA ON-TIME	.00114	.00010	.00120	.00017	.00114	.00010	.00492	.00057
MOON RADIUS	.00010	.00014	.00672	.00131	.00010	.00014	.02586	.00473

MISSION IV FRAME 22

S/C ALTITUDE 2979 KM
CAMERA TILT ∠ 1.5 °
ORBIT INCLINATION 85. °
S/C TRUE ANOMALY 42.4 °
μ CAMERA AXIS 42.9 °
λ CAMERA AXIS 98.0 °
μ NADIR 43.0 °
λ NADIR 94.6 °
NOTE: 5TH OF SERIES REGARDING ATTITUDE MANEUVERS

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.807 ° 24.4 KM	.685 20.8	.937 28.9	1.54 46.7	.954 28.9	.746 22.6	1.50 45.5	7.22 219
NAVIGATION	.00376	.00111	.00421	.00291	.00376	.00111	.00289	.00265
ATTITUDE	.807	.685	.937	1.54	.954	.746	1.50	1.82
CAMERA ON-TIME	.00103	.00024	.00124	.00084	.00108	.00024	.00085	.00072
MOON RADIUS	.00010	.00125	.00635	.00479	.00005	.00125	.02155	.03145

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

ERROR SET FRAMES RESULTS

MISSION IV
FRAME 75

S/C ALTITUDE 6125. KM
CAMERA TILT ∠ 0.3 °
ORBIT INCLINATION 85. °
S/C TRUE ANOMALY 179. °
μ CAMERA AXIS 0.5 °
λ CAMERA AXIS -147. °
μ NADIR 0.1 °
λ NADIR 146. °
NOTE: ~~CELESTIAL ALIGN MENT; R(-192°) P(45°) Y(0°);~~

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT *		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.826° (25.0 KM) [a]	.434 (13.1)	1.51 (45.7)	1.07 (32.4)	.887 (26.9)	.446 (13.5)	ALL OTHER POINTS OFF	
NAVIGATION	0 [b]	0	0	0	0	0	MOON	
ATTITUDE	.826°	.434	1.51	1.07	.887	.446		
CAMERA ON-TIME	.00055	.00025	.00106	.00026	.00065	.00025		
MOON RADIUS	.00013	.00033	.0174	.00970	.00013	.00033		

MISSION ____
FRAME ____

S/C ALTITUDE ____ KM
CAMERA TILT ∠ ____ °
ORBIT INCLINATION ____ °
S/C TRUE ANOMALY ____ °
μ CAMERA AXIS ____ °
λ CAMERA AXIS ____ °
μ NADIR ____ °
λ NADIR ____ °
NOTE: ____

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	° KM							
NAVIGATION								
ATTITUDE								
CAMERA ON-TIME								
MOON RADIUS								

MISSION ____
FRAME ____

S/C ALTITUDE ____ KM
CAMERA TILT ∠ ____ °
ORBIT INCLINATION ____ °
S/C TRUE ANOMALY ____ °
μ CAMERA AXIS ____ °
λ CAMERA AXIS ____ °
μ NADIR ____ °
λ NADIR ____ °
NOTE: ____

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	° KM							
NAVIGATION								
ATTITUDE								
CAMERA ON-TIME								
MOON RADIUS								

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

* μ, LATITUDE; λ, LONGITUDE

GIVING CONSERVATIVE ERRORS

[a] KM ON MOON

[b] NOT AVAILABLE

ERROR SET FRAMES RESULTS

MISSION V FRAME 21

S/C ALTITUDE 3343. KM
CAMERA TILT ∠ 17.0 °
ORBIT INCLINATION 85. °
S/C TRUE ANOMALY 230. °
μ CAMERA AXIS −83.9 °
λ CAMERA AXIS −179. °
μ NADIR −50.7 °
λ NADIR −69.3 °
NOTE: R(−31°) P(170°) Y(0°)

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT *		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.552° / 16.7 KM	2.65 / 80.0	.994 / 30.1	.930 / 25.2	.560 / 17.0	2.65 / 80.3	.634 / 19.2	1.06 / 31.9
NAVIGATION	.00368°	.149	.0208	.0595	.00368	.149	.00236	.0257
ATTITUDE	.552	2.64	.993	.825	.560	2.64	.634	1.06
CAMERA ON-TIME	.00024	.00932	.00120	.00351	.00024	.00932	.00026	.00123
MOON RADIUS	.00374	.186	.0350	.0734	.00374	.186	.0103	.0320

MISSION V FRAME 22

S/C ALTITUDE 5107. KM
CAMERA TILT ∠ 10.1 °
ORBIT INCLINATION 85. °
S/C TRUE ANOMALY 204 °
μ CAMERA AXIS −27.2 °
λ CAMERA AXIS −114. °
μ NADIR −25.6 °
λ NADIR −77.3 °
NOTE: R(−20°) P(164°) Y(0°)

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.151° / 4.58 KM	.956 / 29.0	.423 / 13.8	3.74 / 113.	.149 / 4.50	.965 / 29.2	.490 / 14.8	.781 / 23.7
NAVIGATION	.0116°	.00332	.00829	.0649	.0116	.00332	.0119	.00252
ATTITUDE	.151	.956	.423	3.74	.148	.965	.490	.781
CAMERA ON-TIME	0	0	0	.00082	0	0	0	0
MOON RADIUS	.00125	.0139	.00200	.0893	.00125	.0139	.00562	.00895

MISSION V FRAME 32

S/C ALTITUDE 1395. KM
CAMERA TILT ∠ 21.0 °
ORBIT INCLINATION 85. °
S/C TRUE ANOMALY 156. °
μ CAMERA AXIS 24.8 °
λ CAMERA AXIS −138. °
μ NADIR 22.7 °
λ NADIR −117. °
NOTE: R(33°) P(160°) Y(0°)

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.043° / 1.28 KM	.252 / 7.52	.0655 / 1.97	.310 / 9.80	.0408 / 1.24	.261 / 7.90	.195 / 5.90	.865 / 26.8
NAVIGATION	.00925°	.00300	.00722	.00169	.00325	.00300	.0151	.00223
ATTITUDE	.0414	.250	.0625	.310	.0397	.261	.194	.884
CAMERA ON-TIME	.00102	.00127	.00109	.00089	.00102	.00029	.00160	.00218
MOON RADIUS	.00037	.0122	.00607	.0154	.00037	.0122	.0209	.0442

ERROR SET FRAMES RESULTS

MISSION V FRAME 38

S/C ALTITUDE 98.0 KM
CAMERA TILT ∠ 59.2 °
ORBIT INCLINATION 85 °
S/C TRUE ANOMALY 358 °
μ CAMERA AXIS -1.0 °
λ CAMERA AXIS 49.5 °
μ NADIR -1.0 °
λ NADIR 55.5 °
NOTE: ~~APOLLO PHASE R(96°) Y(-8°) P(-18°)~~

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT *		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.0184° / .558 KM	.190 / 5.76	.0745 / 2.25	1.03 / 31.3	.0189 / .577	.197 / 5.98	.0870 / 2.64	.239 / 7.24
NAVIGATION	.00760°	.00521	.00682	.0153	.00758°	.00521	.00605	.00493
ATTITUDE	.0167	.188	.0740	1.03	.0171	.195	.0859	.237
CAMERA ON-TIME	.00179	.00023	.00178	.00033	.00179	.00023	.00184	.00004
MOON RADIUS	.00015	.0281	.00483	.0774	.00815	.0281	.0125	.0312

MISSION V FRAME 63

S/C ALTITUDE 95.2 KM
CAMERA TILT ∠ 27.3 °
ORBIT INCLINATION 85 °
S/C TRUE ANOMALY 359 °
μ CAMERA AXIS -0.4 °
λ CAMERA AXIS 32.8 °
μ NADIR -0.3 °
λ NADIR 31.0 °
NOTE: ~~R(27°) P(16°) Y(-87°)~~

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.0130° / .395 KM	.0134 / .405	.0121 / .362	.0174 / .580	.0136 / .414	.0137 / .414	.0205 / .623	.0442 / 1.34
NAVIGATION	.00592	.00057	.00525	.00014	.00992	.00057	.01042	.00031
ATTITUDE	.00813	.0128	.00647	.0155	.00912	.0113	.0148	.0402
CAMERA ON-TIME	.00180	.00014	.00184	.00013	.00180	.00014	.00184	.00005
MOON RADIUS	.00068	.00210	.00182	.0116	.00068	.00286	.00946	.0327

MISSION V FRAME 102

S/C ALTITUDE 247.8 KM
CAMERA TILT ∠ 34.1 °
ORBIT INCLINATION 85 °
S/C TRUE ANOMALY 49.5 °
μ CAMERA AXIS 48.3 °
λ CAMERA AXIS 1.0 °
μ NADIR 51.2 °
λ NADIR 8.6 °
NOTE: ~~R(86°) Y(-23°) P(-119°)~~

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.0217° / 2.16 KM	.162 / 4.85	.136 / 4.16	.220 / 6.93	.0735 / 2.23	.165 / 5.00	.554 / 16.8	1.17 / 35.5
NAVIGATION	.00559°	.00122	.00561	.00267	.00559°	.00275	.00589	.00123
ATTITUDE	.0212	.162	.136	.220	.0730	.165	.554	1.17
CAMERA ON-TIME	.00159	.00011	.00157	.00028	.00159	.00011	.00139	.00020
MOON RADIUS	.00220	.0137	.00511	.0210	.00509	.0137	.0205	.0322

μ, LATITUDE; λ, LONGITUDE

* GIVING CONSERVATIVE ERRORS

4 KM ON MOON

ERROR SET FRAMES RESULTS

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

MISSION V FRAME 109

S/C ALTITUDE 97.3 KM
CAMERA TILT ∠ 10.1 °
ORBIT INCLINATION 85. °
S/C TRUE ANOMALY 358. °
μ CAMERA AXIS 0.2 °
λ CAMERA AXIS −1.1 °
μ NADIR 0.1 °
λ NADIR −0.5 °
NOTE: ~~APOLLO FRAME, R(32°) P(−25°) Y(−22°) TYPICAL ATTITUDE ERRORS~~

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT *		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.0094° .286 KM	.0080 .266	.0113 .342	.0110 .332	.00994 .301	.00909 .275	.0159 .481	.0182 .552
NAVIGATION	.00657°	.00194	.00659	.00209	.00657	.00194	.00682	.00217
ATTITUDE	.00853	.00822	.00899	.00941	.00723	.00852	.0134	.0154
CAMERA ON-TIME	.00180	.00014	.00180	.00015	.00180	.00014	.00181	.00018
MOON RADIUS	.00010	.00248	.00034	.00521	.00010	.00248	.00479	.00946

MISSION V FRAME 130

S/C ALTITUDE 233.5 KM
CAMERA TILT ∠ 7.1 °
ORBIT INCLINATION 85. °
S/C TRUE ANOMALY 47.0 °
μ CAMERA AXIS 49.3 °
λ CAMERA AXIS −2.6 °
μ NADIR 48.8 °
λ NADIR −3.9 °
NOTE: ~~R(−16°) P(−13°) Y(−93°)~~

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	.0202° .612 KM	.0267 .805	.0249 .757	.0275 .835	.0219 .665	.0271 .821	.0215 .652	.0523 1.59
NAVIGATION	.0106°	.00761	.0107	.00752	.0106	.00761	.0110	.00730
ATTITUDE	.0171	.0254	.0225	.0264	.0191	.0259	.0174	.0502
CAMERA ON-TIME	.00142	.00035	.00142	.00022	.00142	.00035	.00132	.00052
MOON RADIUS	.00035	.00252	.00056	.00168	.00035	.00252	.00590	.0101

MISSION ____ FRAME ____

S/C ALTITUDE KM
CAMERA TILT ∠ °
ORBIT INCLINATION °
S/C TRUE ANOMALY °
μ CAMERA AXIS °
λ CAMERA AXIS °
μ NADIR °
λ NADIR °
NOTE:

LENS	TELEPHOTO				WIDE-ANGLE			
ERROR SOURCE	CAMERA AXIS		EVAL BORDER POINT		CAMERA AXIS		EVAL BORDER POINT	
	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$	$\nabla\mu$	$\nabla\lambda$
TOTAL	° KM							
NAVIGATION								
ATTITUDE								
CAMERA ON-TIME								
MOON RADIUS								

2.0 METHOD OF ANALYSIS

2.1 General

Nine EVAL Program points in each photographic frame for both telephoto and wide-angle lenses are examined for error analysis as indicated in Figure 1, errors in selenographic latitude (μ) and longitude (λ) being determined (along with eigenvalues and associated rotation angle described in Appendix H). The border points

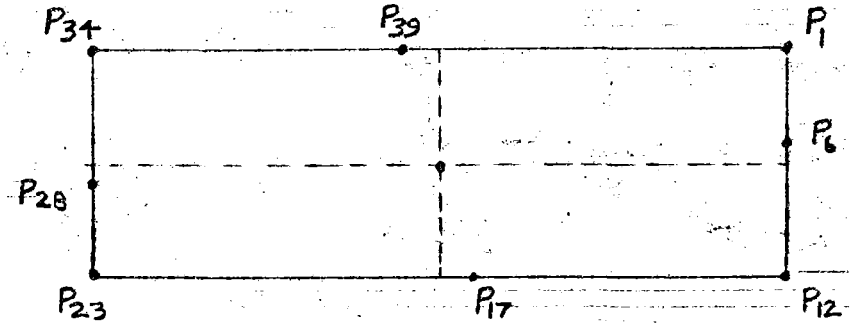


Figure 1, EVAL Program Points Examined in Each Frame for Error Analysis, for Both Telephoto and Wide-Angle Lenses

include the photo corners and points approximately midway between them.

The errors are obtained from the fundamental relationship

$$\left[P_T\right] = \left[S_T\right]\left[M_T\right]\left[S_T\right]^T = \begin{bmatrix} \sigma_{P_{0\mu}}^2 & \sigma_{P_{0\mu}P_{0\lambda}}^2 & & & & \\ \sigma_{P_{0\lambda}}^2 & \sigma_{P_{1\mu}}^2 & & \text{CORRELATION TERMS} & & \\ & \sigma_{P_{1\lambda}}^2 & & & & \\ & & \sigma_{P_{6\mu}}^2 & & & \\ & & & & & \\ \text{SYMMETRICAL} & & & & & \sigma_{P_{39\lambda}}^2 \end{bmatrix}_T \quad (1)$$

for the telephoto lens, and

$$\left[P_W\right] = \left[S_W\right]\left[M_W\right]\left[S_W\right]^T = \begin{bmatrix} \sigma_{P_{0\mu}}^2 & \sigma_{P_{0\mu}P_{0\lambda}}^2 & & & & \\ \sigma_{P_{0\lambda}}^2 & \sigma_{P_{1\mu}}^2 & & \text{CORRELATION TERMS} & & \\ & \sigma_{P_{1\lambda}}^2 & & & & \\ & & \sigma_{P_{6\mu}}^2 & & & \\ & & & & & \\ \text{SYMMETRICAL} & & & & & \sigma_{P_{39\lambda}}^2 \end{bmatrix}_W \quad (2)$$

for the wide-angle lens.

2.0 METHOD OF ANALYSIS, cont'd

2.1 General, cont'd

The sensitivity matrices $[S_T]$ and $[S_W]$ in equations (1) and (2) respectively are obtained by the finite difference method of perturbing the 11 nominal input (basic error-source) parameters of program EVAL (using a modified version thereof designated PERVAL). The 11 parameters include six cartesian state-vector parameters (expressed in selenographic, mean, 1950.0 coordinates), three maneuver angles, the camera-on-time (GMT), and moon radius. The sensitivity matrices are

$$[S_T] = \begin{bmatrix} \frac{\partial P_{0m}}{\partial x} & \frac{\partial P_{0m}}{\partial y} & \frac{\partial P_{0m}}{\partial z} & \frac{\partial P_{0m}}{\partial \dot{x}} & \frac{\partial P_{0m}}{\partial \dot{y}} & \frac{\partial P_{0m}}{\partial \dot{z}} & \frac{\partial P_{0m}}{\partial \Phi} & \frac{\partial P_{0m}}{\partial \Theta} & \frac{\partial P_{0m}}{\partial \Psi} & \frac{\partial P_{0m}}{\partial t} & \frac{\partial P_{0m}}{\partial R_m} \\ \frac{\partial P_{0\lambda}}{\partial x} & \frac{\partial P_{0\lambda}}{\partial y} & \frac{\partial P_{0\lambda}}{\partial z} & \frac{\partial P_{0\lambda}}{\partial \dot{x}} & \frac{\partial P_{0\lambda}}{\partial \dot{y}} & \frac{\partial P_{0\lambda}}{\partial \dot{z}} & \frac{\partial P_{0\lambda}}{\partial \Phi} & \frac{\partial P_{0\lambda}}{\partial \Theta} & \frac{\partial P_{0\lambda}}{\partial \Psi} & \frac{\partial P_{0\lambda}}{\partial t} & \frac{\partial P_{0\lambda}}{\partial R_m} \\ \frac{\partial P_{1\mu}}{\partial x} & \cdots & & & & & & & & & \vdots \\ \vdots & & & & & & & & & & \\ \frac{\partial P_{39\lambda}}{\partial x} & \cdots & & & & & & & & & \frac{\partial P_{39\lambda}}{\partial R_m} \end{bmatrix}^T \quad (3)$$

for the telephoto lens (where Φ, Θ, and Ψ denote roll, pitch, and yaw maneuver angles, respectively), and

$$[S_W] = \begin{bmatrix} \frac{\partial P_{0m}}{\partial x} & \frac{\partial P_{0m}}{\partial y} & \frac{\partial P_{0m}}{\partial z} & \frac{\partial P_{0m}}{\partial \dot{x}} & \frac{\partial P_{0m}}{\partial \dot{y}} & \frac{\partial P_{0m}}{\partial \dot{z}} & \frac{\partial P_{0m}}{\partial \Phi} & \frac{\partial P_{0m}}{\partial \Theta} & \frac{\partial P_{0m}}{\partial \Psi} & \frac{\partial P_{0m}}{\partial t} & \frac{\partial P_{0m}}{\partial R_m} \\ \frac{\partial P_{0\lambda}}{\partial x} & \frac{\partial P_{0\lambda}}{\partial y} & \frac{\partial P_{0\lambda}}{\partial z} & \frac{\partial P_{0\lambda}}{\partial \dot{x}} & \frac{\partial P_{0\lambda}}{\partial \dot{y}} & \frac{\partial P_{0\lambda}}{\partial \dot{z}} & \frac{\partial P_{0\lambda}}{\partial \Phi} & \frac{\partial P_{0\lambda}}{\partial \Theta} & \frac{\partial P_{0\lambda}}{\partial \Psi} & \frac{\partial P_{0\lambda}}{\partial t} & \frac{\partial P_{0\lambda}}{\partial R_m} \\ \frac{\partial P_{1\mu}}{\partial x} & \cdots & & & & & & & & & \vdots \\ \vdots & & & & & & & & & & \\ \frac{\partial P_{39\lambda}}{\partial x} & \cdots & & & & & & & & & \frac{\partial P_{39\lambda}}{\partial R_m} \end{bmatrix}^W \quad (4)$$

for the wide-angle lens.

The covariance matrices of error sources are

$$[M_T] = \begin{bmatrix} 6\times6 \text{ COVARIANCE MATRIX } [N] \text{ OF NAVIGATION ERRORS, SELENOCENTRIC, MEAN, 1950.0} & 0 & 0 & 0 \\ 0 & 3\times3 \text{ COVARIANCE MATRIX } [R_T] \text{ OF MANEUVER ERRORS} & 0 & 0 \\ 0 & 0 & \sigma_t^2 & 0 \\ 0 & 0 & 0 & \sigma_{R_m}^2 \end{bmatrix}^T \quad (5)$$

2.0 METHOD OF ANALYSIS, cont'd

2.1 General, cont'd

for the telephoto lens and

$$M_W = \begin{bmatrix} \text{6 x 6 COVARIANCE MATRIX } [N] \text{ OF NAVIGATION ERRORS, SELENOCENTRIC, MEAN, 1950.0} & 0 & 0 & 0 \\ 0 & \text{3x3 COVARIANCE MATRIX } [R_W] \text{ OF MANEUVER ERRORS} & 0 & 0 \\ 0 & 0 & \sigma_t^2 & 0 \\ 0 & 0 & 0 & \sigma_{R_m}^2 \end{bmatrix}_W \quad (6)$$

for the wide-angle lens, statistical independence pertaining between the input sub-(covariance) matrices as indicated.

The input errors are discussed in Section 3.0.

Sample sensitivities are given in Appendix J.

2.0 METHOD OF ANALYSIS, cont'd

2.2 Error Uncertainty versus Bias Error

Although all parameter errors exhibit random behavior over long periods of time, some variables contain low-frequency components which give the parameter a nominal value (with smaller associated fluctuation) during the time of interest concerned with and pertinent to the study. If this nominal value is determinable, it can be removed, and the remaining high-frequency uncertainty considered the parameter error about the new nominal value. Figure 1 illustrates determining of the bias error $\bar{P}$ for a parameter P, nominally zero before the bias determination.

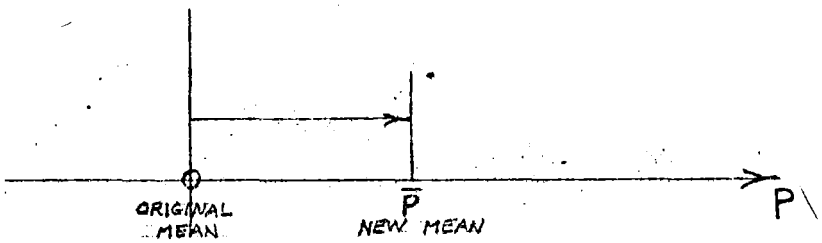


Figure 1, Removing Determinable Bias Error $\bar{P}$ of Parameter P

The original probability density of P and the probability density resulting after removal of $\bar{P}$ are illustrated in Figure 2 for normal distributions; the (desired) reduction in standard deviation occurs, as the initial standard deviation σ_{P_i} was large enough to include the entire random fluctuation. The quantity σ_{P_f} is the standard deviation resulting after removal of $\bar{P}$.

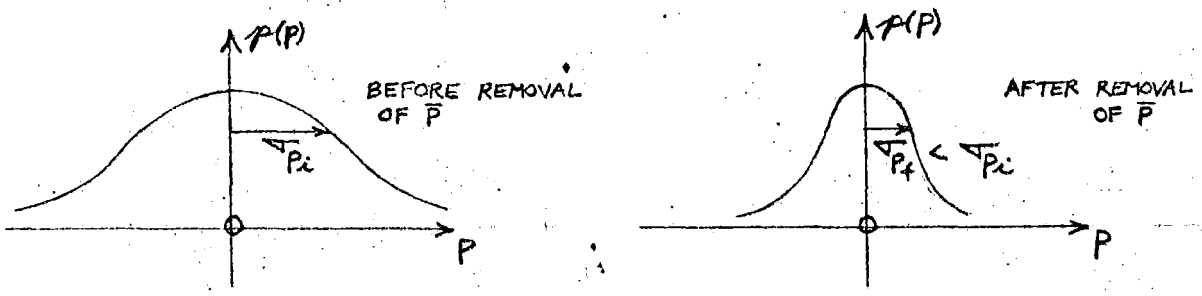


Figure 2, Probability Densities of P Before and After Removal of $\bar{P}$

Such bias errors are removed wherever possible in the improved postmission study, resulting in new nominal values for the following parameters:

- Time
- State vector
- Attitude angles
- Camera geometry

2.0 METHOD OF ANALYSIS

2.3 Choice of Frames for Analysis

2.3.1 Introduction

Photography frames examined for error analysis fall into two categories: frames representative of photographs of Apollo sites, and frames indicative of the errors present in photographs of areas other than the Apollo sites.

2.3.2 Photo Frames of Apollo Sites

Apollo sites of interest are designated IP-1, IIP-2, IIP-6, IIP-8, IIP-11, IIP-13, IIIP-9, IIIP-11, and IIIP-12 in the LO III final report (ref 1). Figure 1 gives Apollo frames of interest (and examined for error analysis) for each mission, and the corresponding site designation. Where a series of frames are taken for a given photo pass, the frame examined for error analysis is the first of two, second of four, fourth of eight, and eighth of sixteen, as the errors are virtually unaffected from one end of the pass to the other. For Mission IV photographs, specific frames were of interest, and examined as listed in Figure 1.

2.3.3 Frames Examined Other Than for Apollo Sites ("Additional" Frames)

A procedure was worked out for choosing "additional" frames to examine for error analysis, indicative of errors in photographs taken of areas other than Apollo sites. For each mission all passes were noted for areas other than the Apollo sites of Figure 1; a representative frame for each pass was listed (first of two, second of four, etc. frames in a sequence) along with camera axis, tilt angle, and spacecraft altitude. A frame was then chosen for error analysis if it was unique as regards tilt angle and spacecraft altitude, or if it was representative of a number of other frames. Where a frame was chosen as representative, the frame ordinarily chosen for error analysis was such as to give a conservative error representation for the other frames, corresponding to greater spacecraft altitude and camera axis tilt angle. In general a frame chosen as representative would have a tilt angle within $\pm$ 2.5^{0} of the frame it represents, and an altitude within $\pm$ 8 km for altitudes in the neighborhood of 50 km (and within the same percentage for greater altitude except for Mission IV: within $\pm$ 150 km). For Mission IV, frames were also examined representative of typical maneuver sequences.

In choosing a frame for error analysis, deeming it representative of other frames,

IDENTIFICATION NUMBER FROM L.O. III FINAL REPORT	AREA*	MISSION I FRAME	MISSION I MISSION TARGET	MISSION II FRAME	MISSION II MISSION TARGET	MISSION III FRAME	MISSION III MISSION TARGET	MISSION IV FRAME	MISSION IV MISSION TARGET	MISSION V FRAME	MISSION V MISSION TARGET
IP-1	A	59	IA-1			28	IIIP-2A	65	—	38	V-3.1
						34	IIIP-2B	66	—	42	V-6
										45	V-8A
										49	V-8B
IIP-2	B			38	P-2	12	IIIP-1	73	—	52	V-9.1
										56	V-11A
										60	V-11B
IIP-6	C	92	IA-3	79	P-6A	55	IIIP-5A	84	—	64	V-13
				87	P-6B	63	IIIP-5B	85	—	72	V-16A
						72	IIIS-5			76	V-16B
IIP-8	D	125	IA-5	93	S-7	89	IIIP-7A	101	—	109	V-27A
				116	P-8A	97	IIIP-7B	102	—	113	V-27B
				124	P-8B			108	—		
				132	P-8C			109	—		
				137	S-11						
IIP-11	E	137	—	166	P-11A	120	IIIS-21	120	—		
				174	P-11B			121	—		
								125	—		
IIP-13	F			200	P-13A	161	IIIS-25	143	—		
				208	P-13B	166	IIIP-10	144	—		
IIIP-9	G	164	IA-7			136	IIIS-24	125	—		
						140	IIIP-9A				
						148	IIIP-9B				
						156	IIIP-9C				
IIIP-11	H	175	—			171	IIIS-27	137	—	170	V-42A
		179	IA-8.1			176	IIIP-11			174	V-42B
IIIP-12	I	191	IA-9.2A			172	IIIS-28	143	—		
		207	IA-9.2B			182	IIIP-12B.2	144	—		
						192	IIIP-12A				
						202	IIIP-12B.1				
						208	IIIP-12C				

* Engineering work designation

Figure 1, Designation of Apollo Frames Examined For Error Analysis For Each Mission

2.0 METHOD OF ANALYSIS, cont'd

2.3 Choice of Frames for Analysis, cont'd

2.3.3 Frames Examined Other Than for Apollo Sites ("Additional" Frames), cont'd

care was taken to see that the maneuver angle magnitudes were approximately the same for the frames; otherwise a frame was examined specifically because the differences in maneuver angle magnitudes were notable, in the neighborhood of 100° total for all three axes. A notation was made on the result sheet of Section 5.0 for a given frame if the total maneuver angle for all three axes ≥ 120°.

Figure 2 lists the "additional" frames examined for each mission, noting items of interest for the frames.

MISSION I		MISSION II		MISSION III		MISSION IV		MISSION V	
FRAME	NOTE	FRAME	NOTE	FRAME	NOTE	FRAME	NOTE	FRAME	NOTE
12		22		22		6		21	R(-31) P(170) Y(0)
28	R(-180) P(0) Y(0)	26		37	R(90) Y(0) P(-55)	10	MANEUVER SERIES	22	R(-20) P(164) Y(0)
32		33		38		14	BEGINNING WITH	29	R(68) P(-177) Y(0)
42		34	R(164) Y(0) P(0)	39		18	CELESTIAL ALIGNMENT	32	R(33) P(160) Y(0)
46		62		41		22		34	
75		75	R(-165) Y(0) P(0)	47		25	CELESTIAL R(167) P(45) Y(0)	37	
84		99		69		30	5TH MANEUVER IN SERIES	41	
103		141		73		42	5TH MANEUVER IN SERIES	54	
116	R(180) P(0) Y(0)	162		75		75	CELESTIAL R(-192) P(45) Y(0)	63	
135		196		78		142(B)	2ND MANEUVER IN SERIES	91	
139		214		81		146	CELESTIAL R(162) Y(-19) P(40)	102	
150		215		102		154	CELESTIAL	103	R(48) P(164) Y(0)
154				121	R(169) P(0) Y(0)	165	CELESTIAL R(-156) P(39) Y(0)	117	
173				213		178	CELESTIAL R(133) P(42) Y(0)	130	
174				215				168	

Figure 2, Additional Frames Examined for Error Analysis

2.0 METHOD OF ANALYSIS, cont'd

2.3 Choice of Frames for Analysis, cont'd

2.3.4 Error Code

The error analysis frames comprise the error code used for all frames examined for nominal results in the improved postmission study. The error code designation, established for each mission, signifies(for any frame of interest) the frame examined for error analysis deemed most representative of the errors incurred in the frame of interest. The determination is based upon relative spacecraft altitude, tilt angle, and maneuver angle magnitudes; Appendix D gives the error code for each frame.

2.3.5 References

1. TBC Document D2-100753 Lunar Orbiter III, Final Report, September 6, 1967.

3.0 INPUT ERRORS

3.1 Introduction

Input errors to the study are generally covariance matrices corresponding to the error-producing nominal inputs to the EVAL Program. These include a covariance matrix $[N]$ of navigation errors, error sources from which are computed the covariance matrices $[R_T]$ and $[R_W]$ of maneuver angle errors at final attitude for the telephoto and wide-angle lenses respectively, camera-on-time error σ^2_t, and moon-radius error $\sigma^2_{R_m}$.

3.2 Covariance Matrix of Navigation Errors $[N]$:

The orbit determination program ascertains the state vector (TRANSF+2 input to the EVAL Program) and corresponding covariance matrix as epoch time (TRANST input to the EVAL Program), a time preceding the first photo in a sequence by approximately two minutes for most passes. The state vector is obtained in selenocentric true vernal equinox of date cartesian coordinates, but referred to selenocentric mean vernal equinox of 1950.0 cartesian coordinates for input to the EVAL Program. The associated covariance matrix of navigation errors $[N]$ is retained in selenocentric true of date coordinates, however, as the coordinate systems are only a fraction of a degree apart, an error over-ridden by assumptions relative to the orbit determination program model.

Punched output cards describing $[N]$ are available from the orbit determination program, and converted for use in the 1108 error analysis program.

It is noted that the navigation errors do not include the effect of uncertainty in moon gravitational model, but other uncertainties, such as DSN radar errors, K_E error, DSN station-location uncertainty, etc. This omission is discussed in Section 3.2.2.

In some cases $[N]$ is set equal to zero due to unavailability of the navigation covariance matrix; this is done with negligible error for Mission IV, where attitude errors predominate. For other missions, for low-altitude frames, the navigation errors contribute a variance comparable to that for the attitude error for some points in the frame, and a negligible variance for other points.

3.0 INPUT ERRORS, cont'd

3.2.1 Sample Navigation Covariance Matrix

A sample navigation covariance matrix is given below for Mission III, Frame 73. The units along the diagonal are km^2 and $(km/sec)^2$ for the position and velocity submatrices respectively.

$$[N] = \begin{bmatrix} .5106E-02 & -.1671E-02 & -.2121E-02 & .4301E-05 & .1052E-05 & .5455E-05 \\ -.1671E-02 & .5514E-03 & .6790E-03 & -.1441E-05 & -.2852E-06 & -.1879E-05 \\ -.2121E-02 & .6790E-03 & .1028E-02 & -.1431E-05 & -.1032E-05 & -.1339E-05 \\ .4301E-05 & -.1441E-05 & -.1431E-05 & .4607E-08 & -.7371E-09 & .7157E-08 \\ .1052E-05 & -.2852E-06 & -.1032E-05 & -.7371E-09 & .2897E-08 & -.3101E-08 \\ .5455E-05 & -.1879E-05 & -.1339E-05 & .7157E-08 & -.3101E-08 & .1250E-07 \end{bmatrix}$$

3.0 INPUT ERRORS, cont'd

3.2.2 Limitation on Scope of [N]

Introduction

Orbit determination in the presence of mathematical model errors is known to produce erroneous results in both the solution and the associated statistics. This was readily evident in the Lunar Orbiter data for the orbital phase, which has shown that the standard deviations on the solution vector are much more optimistic than is physically possible. The orbit determination program (ODPL) used during the Lunar Orbiter missions obtained statistics on the state vector of 50 - 200 meters for data arcs which contained maximum doppler residuals on the order of 1 to 2 Hz. Initial analysis using photo checkpoint locations as measurement of state vector accuracy indicated that the position of the spacecraft could not be determined to an accuracy greater than 1 or 2 km with existing gravitational models.

To overcome this problem, the existing technique of residual feedback was suggested. This method used feedback from the measurement residual space (two and three-way doppler residuals) to the state estimate space in order to force the covariance matrix of state to be compatible with the actual measurement residuals under the constraint of minimum mean square error.

Discussion

The residual feedback technique was implemented in ODPL for the purpose of obtaining more realistic statistics on the solution vector (Reference 3).

From the use of this technique it became evident that the statistics were a direct measure of the solution fit quality. There was a direct relation between the size of the residuals and the magnitude of the statistics; that is, large residuals produced by model errors resulted in large standard deviations. However, short

3.0 INPUT ERRORS, cont'd

3.2.2 Limitations on Scope of [N], cont'd

three-orbit data arc solutions produced good local data fits and, hence, small statistics on the order of 0.2 km. The total or global model error was not observable in the short arcs and, therefore, the residual feedback statistics represent a lower bound of uncertainty rather than an absolute measure of total error. The technique used for OD solutions, namely, solving for 10 high-order lunar harmonics resulted in small doppler residuals which also resulted in small standard deviations on the solution vector. In Figure 3 is shown two solutions for a single checkpoint location in the Lunar Orbiter III mission. The locations are widely separated, but the statistics from the residual feedback technique indicate that each position is known to an accuracy of a few hundred meters. It is fairly obvious from this plot that global statistics cannot be computed by the feedback technique with three-orbit data arcs.

An analysis was performed to determine the accuracy of the standard OD solution (solve for state vector and 10 high-order harmonics) outside of the data arc involved. It was shown that the solution is poor outside the data arc. In Figure 4 is plotted the standard deviation in the down-range direction for a series of eight orbits during the Lunar Orbiter V mission. Only the first four orbits are contained in the data arc and the small standard deviations are obvious; the reason for the large values during the first orbit are due to an input apriori value of 2 km. It is apparent that this was not the proper value to use since it decayed rapidly to a low value. It can be seen that outside the data arc the standard deviations in the down-range direction grow quite rapidly. After only two orbits the standard deviation is approaching 2 km.

3.0 INPUT ERRORS, cont'd

3.2.2 Limitation on Scope of N , cont'd

Conclusions

Very good fits to the doppler data can be obtained in limited regions (short data arcs) by solving for state and 10 high order lunar harmonics. Extension of this solution beyond the data arc results in increasingly poorer fits as time passes.

Use of the residual feedback technique provided a lower bound for the statistics of short data arc solutions. It is obvious from comparison with checkpoint analysis results that realistic statistics are not generated by this technique.

Long data arcs result in large statistics, indicating that the current lunar gravitational models are not adequate for long arcs. Until a better model is available, global solutions and statistics will not be obtainable. However, with a better model, the feedback technique will provide a check upon the statistics from the orbit determination process.

References

1. TBC Document D2-100818-1, Application of Residual Feedback to Lunar Orbiter Residual Analysis - Final Report.

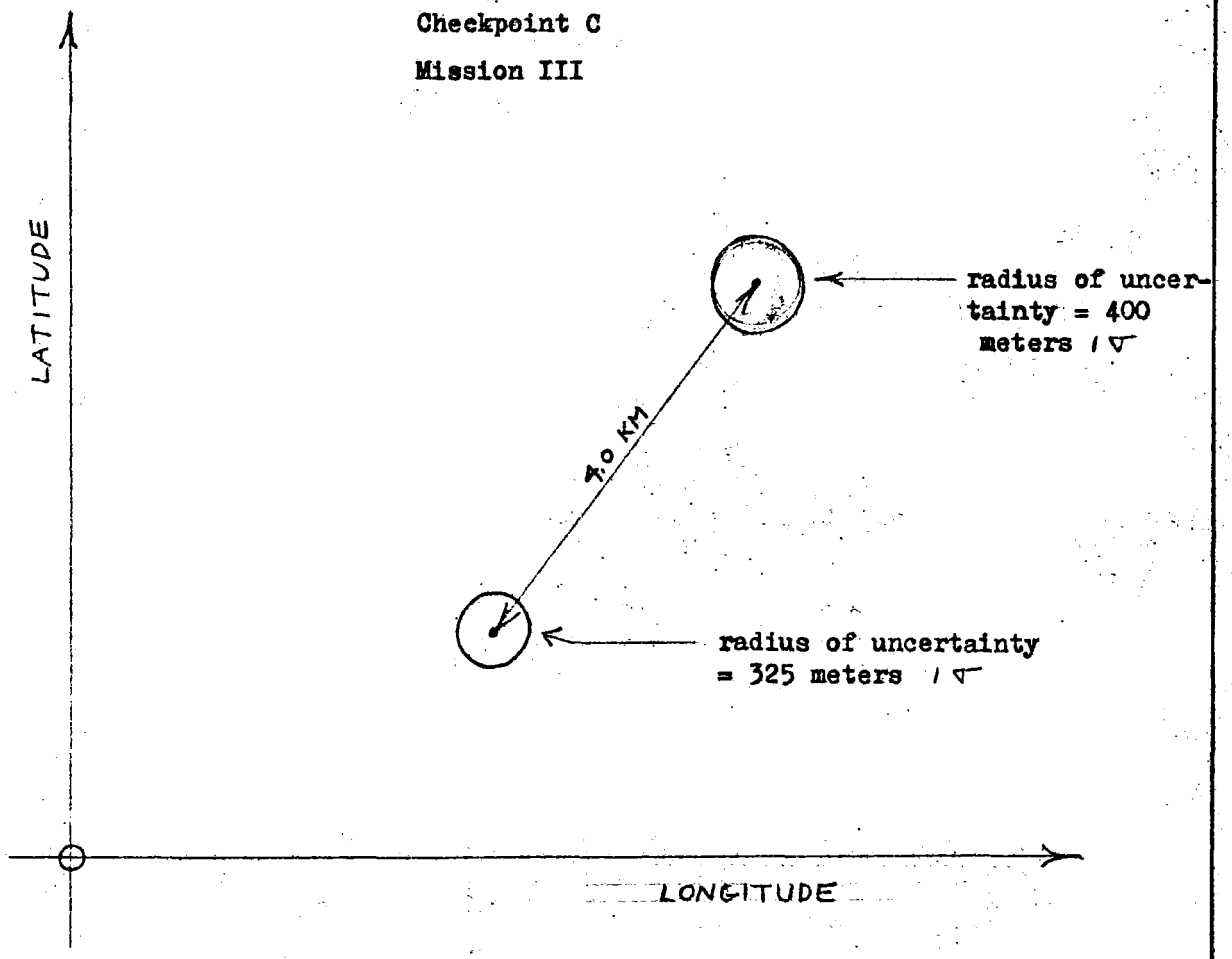


Figure 3, Residual Feedback Statistics for Two OD Solutions

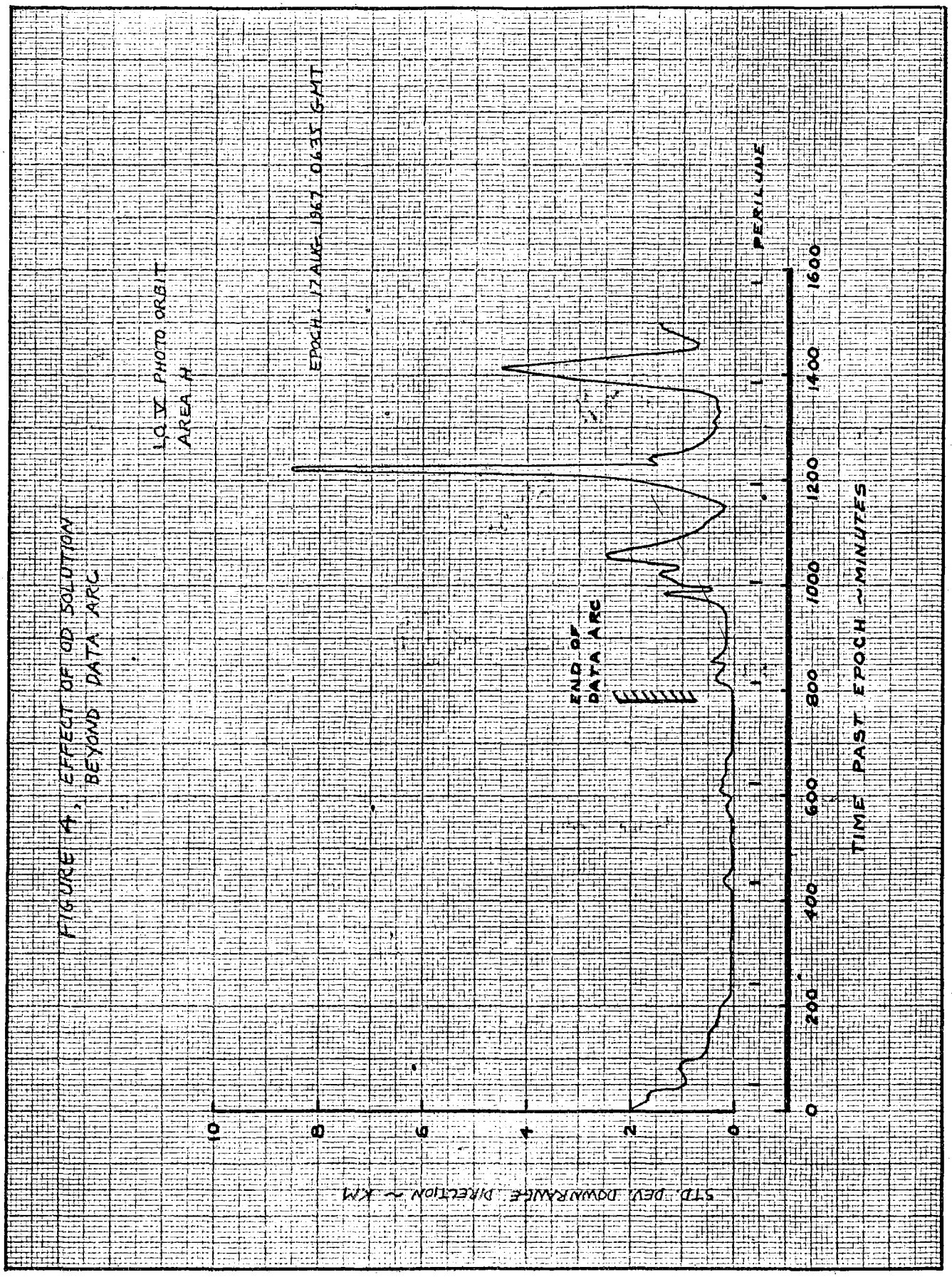


FIGURE 4. EFFECT OF OD SOLUTION BEYOND DATA ARC
LO V PHOTO ORBIT
AREA M
EPOCH: 12 AUG 1967 0635 GMT
PERIGEE
END OF DATA ARC
STD. DEV. DOWNRANGE DIRECTION ~ KM
TIME PAST EPOCH ~ MINUTES
0
200
400
600
800
1000
1200
1400
1600
10
8
6
4
2
0

3.0 INPUT ERRORS, cont'd

3.3 Attitude Covariance Matrix

3.3.1 Introduction

The attitude covariance matrix represents the errors in the EVAL Program maneuver angles, computed for both telephoto and wide-angle lenses, giving $[R_T]$ and $[R_W]$ respectively. The sources of error include data reduction and telemetry errors in establishing limit-cycle position for the gyro axes, gyro limit-cycle rate-integrating-mode drift, gyro rate-mode drift, gyro voltage-to-frequency error, cross-axis drift due to gyro mounting error, non-orthogonal drift (caused in an axis limit-cycling and off-center in the dead band, while a maneuver is effected in another axis), and camera axis-to-spacecraft misalignment. These errors are described below, and the covariance matrices $[R_T]$ and $[R_W]$ synthesized from them.

3.3.2 Initial Orientation Error

Spacecraft attitude is initially established with respect to celestial bodies for Mission I, II, III, and V frames (and the first frame of a Mission IV sequence), giving the initial orientation covariance matrix $[IO_1]$ which comprises a portion of the $[R_T]$ and $[R_W]$ covariance matrices for the frames of interest. For the second and successive frames of a Mission IV sequence, the initial orientation covariance matrix $[IO_2]$ is the attitude covariance matrix ($[R_T]$ or $[R_W]$) for the preceding frame; this is so as celestial realignment is not performed for the second and successive frames in a Mission IV sequence due to mission constraints, a considerable time duration ($\approx \frac{1}{2}$ hr) pertaining between frames. For Missions I, II, III, and V (and single-frame sequences for Mission IV) a single maneuver based upon celestial alignment is involved, the duration of the frame series being less than one minute.

Covariance matrix $[IO_1]$ is derived from the initial orientation error of the inertial reference unit (IRU) axes relative to celestial alignment, resulting via body-mounted celestial sensors; we have

$$[IO_1] = \begin{bmatrix} \sigma_{\phi_0}^2 & 0 & 0 \\ 0 & \sigma_{\theta_0}^2 & 0 \\ 0 & 0 & \sigma_{\psi_0}^2 \end{bmatrix} = \begin{bmatrix} (.0259)^2 & 0 & 0 \\ 0 & (.0111)^2 & 0 \\ 0 & 0 & (.0111)^2 \end{bmatrix} \quad \text{deg}^2, \qquad (1)$$

3.0 INPUT ERRORS, cont'd

3.3 Attitude Covariance Matrix, cont'd

3.3.2 Initial Orientation Error, cont'd

where

$\sigma^2_{\phi_o}$ = roll axis initial orientation variance

= σ^2_A (alignment of canopus tracker null to reference prism $(.025\text{deg})^2$)

+ $\sigma^2_{IRU_A}$ (IRU alignment to reference prism $(.0067\text{deg})^2$).

$\sigma^2_{\theta_o}$ = pitch axis initial orientation variance

= σ^2_{SSN} (alignment of sun-sensor null to mirror $(.006\text{deg})^2$)

+ σ^2_{SSM} (alignment of sun-sensor mirror to reference prism $(.006\text{deg})^2$)

+ $\sigma^2_{IRU_A}$ (IRU alignment to reference prism $(.0067\text{deg})^2$)

+ σ^2_{SSNS} (sun-sensor null shift $(.002\text{deg})^2$).

$\sigma^2_{\psi_o}$ = yaw axis initial orientation variance

= same terms as for the pitch axis, but statistically independent.

It is noted that the attitude errors are arranged in roll, pitch, and yaw order for convenience of analysis regardless of maneuver order; also, the error values used in equation (1) were obtained from reference 1.

Where error analysis is desired for a Mission IV frame other than the initial (celestially aligned) frame, $\left[IO_2\right]$ is used in place of $\left[IO_1\right]$, where

$$\left[IO_2\right]_T = \left[R_T\right] \text{ previous frame} \qquad (2)$$

for the telephoto lens, and

$$\left[IO_2\right]_W = \left[R_W\right] \text{ previous frame} \qquad (3)$$

for the wide-angle case.

3.0 INPUT ERRORS, cont'd

3.3 Attitude Covariance Matrix, cont'd

3.3.3 Execution Errors $[EX_1]$

Some of the maneuver execution gyro errors are applicable at final spacecraft attitude for a multi-axis maneuver, while others require adjustment to final attitude, a function of the maneuver angles. We are interested in the covariance matrices $[R_T]$ and $[R_W]$ of maneuver angle errors applicable at final attitude, since the photo-parameter sensitivities $[S_T]$ and $[S_W]$ are obtained (as far as the maneuver angles are concerned) by perturbing the maneuver angles about final attitude. It is therefore necessary to note which errors apply at final attitude directly --- the execution error covariance matrix $[EX_1]$ considered in this section --- and which will have to be adjusted to final attitude through the multi-axis maneuver --- the initial orientation errors mentioned in the previous section and execution errors $[EX_2]$ of the next section.

Errors constituting $[EX_1]$, applicable to both telephoto and wide-angle lenses, are given by

$$[EX_1] = \begin{bmatrix} \sigma_{\phi_1}^2 & 0 & 0 \\ 0 & \sigma_{\theta_1}^2 & 0 \\ 0 & 0 & \sigma_{\psi_1}^2 \end{bmatrix}_{T \text{ or } W}, \quad \text{deg}^2 \qquad (4)$$

where

$\sigma_{\phi_1}^2$ = roll maneuver angle error transmitted to final attitude

= $T_\phi^2 \sigma_{RM}^2$ (roll gyro rate-mode error, where $\sigma_{RM} = 1.67 \times 10^{-4}$ o/sec drift and T_ϕ is the time duration of the roll maneuver in seconds)

+ $\sigma_{RM_{res}}^2$ (roll gyro rate-mode resolution error; $\sigma_{RM_{res}} = .025^o \times .577 = .0144^o$ as the error is uniformly distributed, and the factor .577 is applied to the 3σ value)

+ $\Phi^2 \sigma_{V/F\%}^2$ (gyro voltage-to-frequency conversion error; $\sigma_{V/F\%} = .001$; Φ = roll maneuver angle)

+ $\sigma_{V/F_{res}}^2$ (gyro voltage-to-frequency resolution error; $\sigma_{V/F_{res}} = .011$, the 3σ value, times $.577 = .00635^o$).

3.0 INPUT ERRORS, cont'd

3.3 Attitude Covariance Matrix, cont'd

3.3.3 Execution Errors $[EX_1]$, cont'd

error values being obtained from reference 1.

$$\sigma^2_{\theta_1} = T^2_\theta \sigma^2_{RM} + \sigma^2_{RM_{res}} + \Theta^2 \sigma^2_{V/F\%} + \sigma^2_{V/F_{res}} \quad deg^2 \quad (5)$$

where T_θ is the pitch maneuver duration in seconds and Θ the pitch maneuver angle in degrees. Finally

$$\sigma^2_{\psi_1} = T^2_\psi \sigma^2_{RM} + \sigma^2_{RM_{res}} + \Psi^2 \sigma^2_{V/F\%} + \sigma^2_{V/F_{res}} \quad (6)$$

where T_ψ is the yaw maneuver duration in seconds and Ψ the yaw maneuver angle in degrees.

3.3.4 Execution Errors $[EX_2]$

Attitude errors (in addition to initial orientation error) requiring adjustment to final spacecraft attitude are next considered. Included in this category are the remaining gyro errors involved in the maneuver, along with gyro RIM (rate-integrating mode) drift and camera-to-spacecraft mounting error. The covariance matrix $[EX_2]_T$ for the telephoto lens is given by

$$[EX_2]_T = \begin{bmatrix} \sigma^2_{\phi_{2T}} & \sigma^2_{\phi_{2T}\theta_{2T}} & \sigma^2_{\phi_{2T}\psi_{2T}} \\ & \sigma^2_{\theta_{2T}} & \sigma^2_{\theta_{2T}\psi_{2T}} \\ \text{SYMMETRICAL} & & \sigma^2_{\psi_{2T}} \end{bmatrix} \quad (7)$$

while for the wide-angle lens

$$[EX_2]_W = \begin{bmatrix} \sigma^2_{\phi_{2W}} & \sigma^2_{\phi_{2W}\theta_{2W}} & \sigma^2_{\phi_{2W}\psi_{2W}} \\ & \sigma^2_{\theta_{2W}} & \sigma^2_{\theta_{2W}\psi_{2W}} \\ & & \sigma^2_{\psi_{2W}} \end{bmatrix} . \quad (8)$$

The elements of $[EX_2]_T$ are

$\sigma^2_{\phi_{2_T}}$ = roll maneuver angle in deg^2

$= \sigma^2_{DR_{2\phi}}$ (roll gyro data reduction error $= \left(\frac{3\sigma \text{ input } DR\phi}{3}\right)^2$ where a normal distribution is assumed)

+

3.0 INPUT ERRORS, cont'd

3.3 Attitude Covariance Matrix, cont'd

3.3.4 Execution Errors $[EX_2]$, cont'd

$+\sigma^2_{LS_{T/L_\phi}}$ (roll gyro limit-cycle telemetry resolution error = $(.577 \times 3\sigma_{\text{input } LS_{T/L_\phi}})^2$ where a uniform distribution is assumed)

$+\sigma^2_{RIM(t_{pix} - T_\phi)}$ (roll gyro rate-integrating mode error during the time from initial orientation to camera on-time, t_{pix}, minus the time T_ϕ of the roll maneuver duration, the error being $\left(\frac{3\sigma_{\text{input RIM}(t_{pix} - T_\phi)}}{3}\right)^2$, a normal distribution being assumed)

$+ T^2_\theta \sigma^2_{CAD}$ (roll gyro cross-axis drift due to pitch maneuver, caused by gyro mechanical mounting error; T_θ is the time duration of the pitch maneuver and $\sigma_{CAD} = 1.11 \times 10^{-4}$ o/sec from reference 1)

$+ T^2_\psi \sigma^2_{CAD}$ (roll gyro cross-axis drift due to yaw maneuver, where T_ψ is the time duration of the yaw maneuver and $\sigma_{CAD} = 1.11 \times 10^{-4}$ o/sec)

$+ \sigma^2_{NOD} T^2_\psi$ (roll gyro non-orthogonal drift due to a yaw maneuver, while the roll axis is off-center in the limit cycle; $\sigma_{NOD} = .00348 \sigma_{\dot\psi_M}$ (reference 2, where $\sigma_{\dot\psi_M}$ is the error in yaw maneuver rate) $= 3.13 \times 10^{-5}$ o/sec, where $\sigma_{\dot\psi_M} = .009$ sec and is normally distributed by assumption)

$+ \sigma^2_{Cam/SC_{\phi_T}}$ (camera axis misalignment in spacecraft for telephoto lens; $\sigma_{Cam/SC_{\phi_T}} = 0.1^\circ/\cos 20^\circ = .106^\circ$ as noted in Appendix A). (9)

For the pitch axis we have

$\sigma^2_{\theta_{2_T}}$ = pitch maneuver angle error in deg^2

$$= \sigma^2_{DR_{2_\theta}} + \sigma^2_{LS_{T/L_\theta}} + \sigma^2_{RIM(t_{pix} - T_\theta)} + T^2_\phi \sigma^2_{CAD} + T^2_\psi \sigma^2_{CAD} + \sigma^2_{NOD} T^2_\psi + \sigma^2_{Cam/SC_{\theta_T}} \quad (10)$$

(where $\sigma_{Cam/SC_{\theta_T}} = .1^\circ$ as noted in Appendix A),

where the errors are analogous to those for the roll axis.

3.0 INPUT ERRORS, cont'd

3.3 Attitude Covariance Matrix, cont'd

3.3.4 Execution Errors EX_2 , cont'd

For the yaw axis the variance is

$$\sigma^2_{\psi_{2_T}} = \sigma^2_{DR_{2_\psi}} + \sigma^2_{LS_{T/L_\psi}} + \sigma^2_{RIM(t_{pix} - T_\psi)} + T^2_\phi \sigma^2_{CAD} +$$

$$+ T^2_\theta \sigma^2_{CAD} + \sigma^2_{NOD}\, T^2_\theta + \sigma^2_{Cam/SC_{\psi_T}} \quad (11)$$

(where $\sigma_{Cam/SC_{\psi_T}} = .1^\circ/\sin 20^\circ = .293^\circ$ as noted in Appendix A),

where the errors are analogous to those for the roll and pitch axes with the following exception: σ_{NOD} is a function of the pitch maneuver rate error (as discussed in reference 2) because of the gyro mounting orientation, whereas in equations (9) and (10) it was a function of the yaw maneuver rate error.

Continuing with the elements of $\left[EX_2\right]_T$ of equation (7),

$$\sigma^2_{\phi_{2_T}\theta_{2_T}} = E(\Delta\phi_{2_T}\Delta\theta_{2_T}) = \sigma^2_{NOD}\, T^2_\psi + T^2_\psi \sigma^2_{CAD} \quad , \qquad (12)$$

as evident from the error source increments pertaining for roll and pitch errors; the camera axis misalignment does not enter in because of statistically independent cone and clock alignment errors, these errors being discussed in Appendix A. The camera axis misalignment does enter into

$$\sigma^2_{\phi_{2_T}\psi_{2_T}} = E(\Delta\phi_{2_T}\Delta\psi_{2_T}) = T^2_\theta \sigma^2_{CAD} + \sigma^2_{Cam/SC_{\phi_T}\, Cam/SC_{\psi_T}} \quad , \qquad (13)$$

where

$$\sigma^2_{Cam/SC_{\phi_T}\, Cam/SC_{\psi_T}} = (\rho = 1)\, \sigma_{Cam/SC_{\phi_T}}\, \sigma_{Cam/SC_{\psi_T}} \qquad (14)$$

$$= (.106)(.293) = .0311 \quad \text{deg}^2 \qquad (15)$$

the same misalignment (clock) error is used for both roll and yaw axes, giving unity correlation coefficient (ρ).

The final element of $\left[EX_2\right]_T$ is

$$\sigma^2_{\theta_{2_T}\psi_{2_T}} = E(\Delta\theta_{2_T}\Delta\psi_{2_T}) = T^2_\phi \sigma^2_{CAD} \quad . \qquad (16)$$

3.0 INPUT ERRORS, cont'd

3.3 Attitude Covariance Matrix, cont'd

3.3.4 Execution Errors $\left[EX_2\right]$, cont'd

The elements of $\left[EX_2\right]_W$ of equation (8) are identical with those of $\left[EX_2\right]_T$ except for the camera axis misalignment error. In mounting the camera, the telephoto lens was first mounted relative to the spacecraft; then the wide-angle lens mounted relative to the telephoto lens, as discussed in Appendix A. Consequently the alignment error is larger for the wide-angle lens than for the telephoto, giving rise to the difference between $\left[EX_2\right]_W$ and $\left[EX_2\right]_T$. Taking the elements of $\left[EX_2\right]_W$ in turn, we have

$$\nabla^2_{\phi_{2_W}} = \nabla^2_{DR_{2_\phi}} + \nabla^2_{LS_{T/L_\phi}} + \nabla^2_{RIM(t_{pix}-T_\phi)} + T^2_\theta \nabla^2_{CAD} + T^2_\psi \nabla^2_{CAD} + \nabla^2_{NOD}\, T^2_\psi + \nabla^2_{Cam/SC_{\phi_W}} \quad (12)$$

(See Appendix A for values used for each mission for $\nabla_{Cam/SC_{\phi_W}}$)

$$\nabla^2_{\theta_{2_W}} = \nabla^2_{DR_{2_\theta}} + \nabla^2_{LS_{T/L_\theta}} + \nabla^2_{RIM(t_{pix}-T_\theta)} + T^2_\phi \nabla^2_{CAD} + T^2_\psi \nabla^2_{CAD} + \nabla^2_{NOD}\, T^2_\psi + \nabla^2_{Cam/SC_{\theta_W}} \quad (13)$$

(See Appendix A for values used for each mission for $\nabla_{Cam/SC_{\theta_W}}$)

$$\nabla^2_{\psi_{2_W}} = \nabla^2_{DR_{2_\psi}} + \nabla^2_{LS_{T/L_\psi}} + \nabla^2_{RIM(t_{pix}-T_\psi)} + T^2_\phi \nabla^2_{CAD} + T^2_\theta \nabla^2_{CAD} + \nabla^2_{NOD}\, T^2_\theta + \nabla^2_{Cam/SC_{\psi_W}} \quad (14)$$

(See Appendix A for values used for each mission for $\nabla_{Cam/SC_{\psi_W}}$)

The correlation terms are

$$\nabla^2_{\phi_{2_W}\theta_{2_W}} = \nabla^2_{\phi_{2_T}\theta_{2_T}} = \nabla^2_{NOD}\, T^2_\psi + T^2_\psi \nabla^2_{CAD}, \quad (15)$$

$$\nabla^2_{\phi_{2_W}\psi_{2_W}} = T^2_\theta \nabla^2_{CAD} + \nabla^2_{Cam/SC_{\phi_W}\, Cam/SC_{\psi_W}}, \quad (16)$$

3.0 INPUT ERRORS, cont'd

3.3 Attitude Covariance Matrix, cont'd

3.3.4 Execution Errors $[EX_2]$, cont'd

where

$$\sigma^2_{Cam/SC\phi_W\ Cam/SC\psi_W} = (\rho = 1)\ \sigma_{Cam/SC\phi_W}\ \sigma_{Cam/SC\psi_W} \quad , \tag{17}$$

and

$$\sigma^2_{\theta_{2_W}\psi_{2_W}} = \sigma^2_{\theta_{2_T}\psi_{2_T}} = T^2_\phi\ \sigma^2_{CAD} \quad . \tag{18}$$

3.3.5 Total Errors

The attitude covariance matrix for the telephoto lens is the sum of the contributions examined, or

$$[R_T] = \begin{bmatrix} F_\phi & 0 & 0 \\ 0 & F_\theta & 0 \\ 0 & 0 & F_\psi \end{bmatrix} [IO_{1 \text{ or } 2}] \begin{bmatrix} F_\phi & 0 & 0 \\ 0 & F_\theta & 0 \\ 0 & 0 & F_\psi \end{bmatrix} + [EX_1] + \begin{bmatrix} F_\phi & 0 & 0 \\ 0 & F_\theta & 0 \\ 0 & 0 & F_\psi \end{bmatrix} [EX_2]_T \begin{bmatrix} F_\phi & 0 & 0 \\ 0 & F_\theta & 0 \\ 0 & 0 & F_\psi \end{bmatrix} , \tag{19}$$

where factors F_ϕ (for roll errors), F_θ (for pitch errors), and F_ψ (for yaw errors) transmit the maneuver angle errors to final attitude as discussed in Appendix B. In equation (19) $[IO_1]$ is used for celestial alignment and $[IO_2]$ for the second and succeeding maneuvers of a Mission IV sequence, where $[IO_2]_T = [R_T]_{\text{previous frame}}$ and $[IO_2]_W = [R_W]_{\text{previous frame}}$ as previously discussed.

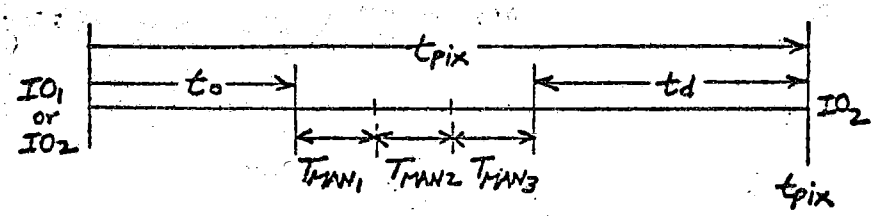
For the wide-angle lens the total errors are

$$[R_W] = \begin{bmatrix} F_\phi & 0 & 0 \\ 0 & F_\theta & 0 \\ 0 & 0 & F_\psi \end{bmatrix} [IO_{1 \text{ or } 2}] \begin{bmatrix} F_\phi & 0 & 0 \\ 0 & F_\theta & 0 \\ 0 & 0 & F_\psi \end{bmatrix} + [EX_1] + \begin{bmatrix} F_\phi & 0 & 0 \\ 0 & F_\theta & 0 \\ 0 & 0 & F_\psi \end{bmatrix} [EX_2]_W \begin{bmatrix} F_\phi & 0 & 0 \\ 0 & F_\theta & 0 \\ 0 & 0 & F_\psi \end{bmatrix} . \tag{20}$$

3.3.6 Maneuver Data Sheet

Figure 1 gives the format used to record input data (regarding the maneuver) required for each frame for computation of $[R_T]$ and $[R_W]$, whether $[IO_1]$ or $[IO_2]$ is involved. These data sheets are compiled for each frame in Appendix C.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☐

MISSION _____

FRAME _____

MAN. ORDER _____

MAN. ANGLES _____

_____

_____

ROLL	PITCH	YAW
$DR_\phi = \pm$ °	$DR_\theta = \pm$ °	$DR_\psi = \pm$ °
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM\ (t_{pix} - T_{MAN_\phi}) = \pm$ °	$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ °	$RIM(t_{pix} - T_{MAN\psi}) = \pm$ °
$T_{MAN_\phi} =$ sec	$T_{MAN_\theta} =$ sec	$T_{MAN\psi} =$ sec.

Figure 1, Maneuver Data Required for Computation of Attitude Errors

3.0 INPUT ERRORS, cont'd

3.3.7 Sample Attitude Covariance Matrices

Sample attitude covariance matrices are given for Mission III, Frame 73. The units are degrees^2.

$$[R_T] = \begin{bmatrix} .7105E\text{-}02 & .1929E\text{-}04 & .2202E\text{-}01 \\ .1929E\text{-}04 & .1170E\text{-}01 & .4041E\text{-}04 \\ .2202E\text{-}01 & .4041E\text{-}04 & .8791E\text{-}01 \end{bmatrix} \text{ deg}^2$$

$$[R_W] = \begin{bmatrix} .9305E\text{-}02 & .1929E\text{-}04 & .3039E\text{-}01 \\ .1929E\text{-}04 & .1210E\text{-}01 & .4041E\text{-}04 \\ .3039E\text{-}01 & .4041E\text{-}04 & .1197E+00 \end{bmatrix} \text{ deg}^2$$

3.0 INPUT ERRORS, cont'd

3.3 Attitude Covariance Matrix, cont'd

3.3.8 References

1. Hurd, M. L., et al, TBC Document D2-100716-1, P-7 and P-8 Mission Error Analyses, November and December, 1966, Lunar Orbiter Contract NAS1-3800, 10/21/66.

2. Hurd, M. L., et al, TBC Document D2-100672-1, P-6 Mission Error Analysis, Lunar Orbiter Contract NAS1-3800, 10/7/66.

3.0 INPUT ERRORS, cont'd

3.4 Camera On-Time Error

3.4.1 Introduction

The sensitivity of location of points in a photo frame of interest (located by selenographic latitude and longitude) to camera-on-time (GMT) is obtained by the finite difference method in perturbing camera-on-time (cot) of program EVAL. The value used for the error in camera-on-time, σ_{cot}, is determined in this section.

3.4.2 Error Sources

The spacecraft programmer clock operates in 0.1 second increments, identifying in time a parameter known as the "time code interrogation pulse" (TCI) by use of these increments. The TCI is identified with a particular time increment if the TCI occurrs in time no more than 0.08 seconds earlier, nor more than 0.02 seconds later than the time increment.* This results in the uniform probability density of Figure 1, enabling a bias error B_{TCI} of -0.03 seconds to be extracted and ap-

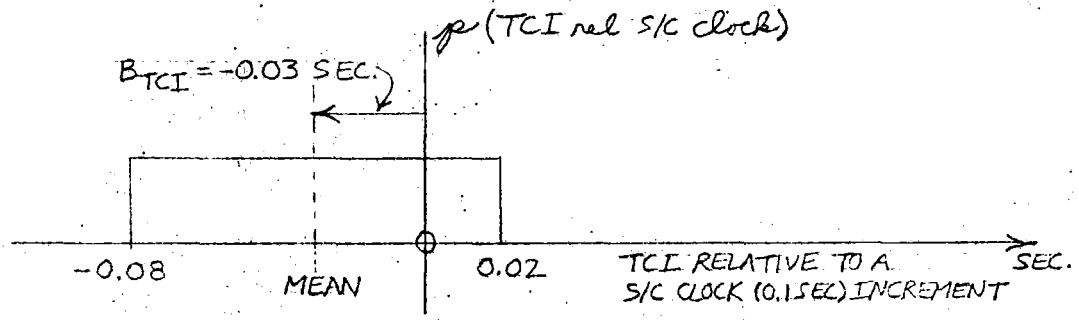


Figure 1, Probability Density of TCI Pulse Relative to Spacecraft-Clock Increment

plied to nominal camera-on-time; the associated uncertainty is σ_{TCI} = 0.0289 sec (0.05x0.577 for a uniform distribution), which will be reduced later for some passes by smoothing over the number of frames involved (for 4 or more frames in a pass).

Operation of the telephoto and wide-angle lenses relative to the TCI introduces for each frame an additional error, determined by reference to Figure 2. It is seen that the bias errors relative to the center of the frame are

* The 0.1 second time increments are noted by the lamp code.

3.0 INPUT ERRORS, cont'd

3.4 Camera On-Time Error, cont'd

3.4.2 Error Sources, cont'd

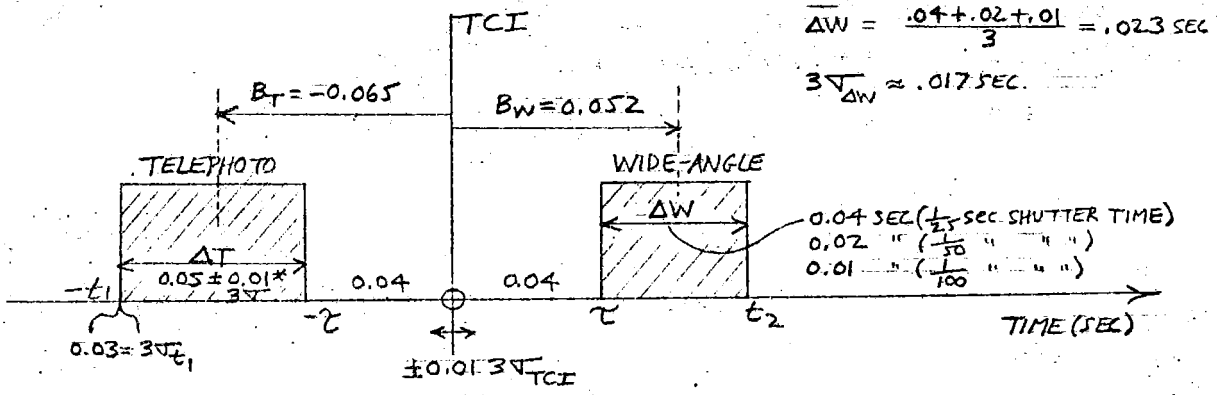


Figure 2, Telephoto(T) and Wide-Angle(W) Exposure Times Relative to TCI Pulse

$$B_T = -\tau - \left[\frac{(t_1-\tau) = \Delta T}{2}\right] = -.04 - .025 = -.065 \text{ sec} \quad (1)$$

$$\overline{B_W} = \tau + \left[\frac{(\overline{t_2-\tau}) = \overline{\Delta W}}{2}\right] = .04 + .012 = .052 \text{ sec.} \quad (2)$$

The uncertainties are

$$\sigma_{B_T} = (1/3)\sqrt{(3\sigma_{TCI})^2 + (\tfrac{1}{2})^2(3\sigma_{\Delta T})^2 + (\tfrac{1}{2})^2(3\sigma_{\Delta t_1})^2} \quad (3)$$

$$= (1/3)\sqrt{(.01)^2 + (\tfrac{1}{2})^2(.01)^2 + (\tfrac{1}{2})^2(.03)^2} = .0188/3 = .00627 \text{ sec;} \quad (4)$$

$$\sigma_{B_W} = (1/3)\sqrt{(3\sigma_{TCI})^2 + (\tfrac{1}{2})^2(3\sigma_{\Delta W})^2} \quad (5)$$

$$= (1/3)\sqrt{(.01)^2 + (\tfrac{1}{2})^2(.017)^2} = .0132/3 = .00440 \text{ sec,} \quad (6)$$

where $\overline{\Delta W} = .023$ sec, $3\sigma_{\Delta W} = .017$ sec, and normal distributions are assumed. Since the uncertainties are small and do not differ greatly, the value

$$\sigma_B = .00627 \text{ sec} \quad (7)$$

will be used for both telephoto and wide-angle cases.

*REFERENCE 1.

3.0 INPUT ERRORS, cont'd

3.4 Camera On-Time Error, cont'd

3.4.3 Smoothing Spacecraft Clock Times

The standard deviation of smoothed spacecraft clock times may be determined by the relation (for the dummy variable x) from reference 2,

$$\sigma_{\hat{x}}^2 = \left(\frac{\partial \hat{x}}{\partial \hat{x}_o}\right)^2 \sigma_{\hat{x}_o}^2 + \left(\frac{\partial \hat{x}}{\partial \dot{\hat{x}}_o}\right)^2 \sigma_{\dot{\hat{x}}_o}^2 + 2\rho_{\hat{x}_o \dot{\hat{x}}_o}\left(\frac{\partial \hat{x}}{\partial \hat{x}_o}\right)\left(\frac{\partial \hat{x}}{\partial \dot{\hat{x}}_o}\right)\sigma_{\hat{x}_o}\sigma_{\dot{\hat{x}}_o} \qquad (8)$$

$$= \sigma_{\hat{x}_o}^2 + t^2\sigma_{\dot{\hat{x}}_o}^2 + 2\rho_{\hat{x}_o \dot{\hat{x}}_o} t\,\sigma_{\hat{x}_o}\sigma_{\dot{\hat{x}}_o} \quad , \qquad (9)$$

where a linear fit has been applied to the points according to the relation

$$\hat{x} = \hat{x}_o + \dot{\hat{x}}_o\, t \qquad (10)$$

in the time interval $-T \le t \le 0$. For least squares smoothing for any probability density function, the relationships (where n is the number of points smoothed) result, so that for the conservative case where t = -T (smaller values resulting for other values of t in the interval),

$$\sigma_{\hat{x}_o}^2 = \frac{4(2n-1)}{2n(n+1)}\sigma_{TCI}^2 \qquad (11)$$

$$\sigma_{\dot{\hat{x}}_o}^2 = \frac{12(n-1)}{nT^2(n+1)}\sigma_{TCI}^2 \qquad (12)$$

$$\rho_{\hat{x}_o \dot{\hat{x}}_o} = \sqrt{\frac{3(n-1)}{2(2n-1)}} \qquad (13)$$

$$\sigma_{\hat{x}}^2 = \frac{4(2n-1)}{2n(n+1)}\sigma_{TCI}^2 \quad . \qquad (14)$$

We then have for various n,

$$\sigma_{\hat{x}} = \sigma_{TCI} = .0289 \text{ sec} \;\Big|\; n = 1 \text{ and } 2 \text{ frame points(cot's)} \qquad (15)$$

$$\sigma_{\hat{x}} = .837\,\sigma_{TCI} = .0242 \text{ sec} \;\Big|\; n = 4 \text{ frames} \qquad (16)$$

$$\sigma_{\hat{x}} = .645\,\sigma_{TCI} = .0186 \text{ sec} \;\Big|\; n = 8 \text{ frames} \qquad (17)$$

$$\sigma_{\hat{x}} = .477\,\sigma_{TCI} = .0138 \text{ sec} \;\Big|\; n = 16 \text{ frames} \quad , \qquad (18)$$

3.0 INPUT ERRORS, cont'd

3.4 Camera On-Time Error, cont'd

3.4.3 Smoothing Spacecraft Clock Times, cont'd

as smoothing is done only for 4, 8, and 16 frame sequences: some exceptions apply due to the nature of the data, so that no smoothing is effected (equivalent to n = 1). Where smoothing is accomplished and applicable to a given frame, notation is made on the Result sheet for the frame in Section 5.0, the code being t_n where n is the number of frames smoothed.

3.4.4 Total Error

The total error is the root-sum-square of the components σ_B and $\sigma_{\hat{x}}$ as the error sources are statistically independent;

$$\sigma_t = \sqrt{\sigma_{\hat{x}}^2 + \sigma_B^2} \Big|_{\text{n frames}} \qquad (19)$$

The results, using equations (15) through (18) are

$$\sigma_t = .0296 \text{ sec} \Big|_{\text{n = 1 and 2 frames}} \qquad (20)$$

$$\sigma_t = .0251 \text{ sec} \Big|_{\text{n = 4 frames}} \qquad (21)$$

$$\sigma_t = .0197 \text{ sec} \Big|_{\text{n = 8 frames}} \qquad (22)$$

$$\sigma_t = .0152 \text{ sec} \Big|_{\text{n = 16 frames}} \qquad (23)$$

3.4.5 References

1. "Photographic Subsystems Reference Handbook for the L. O. Program," Eastman Kodak Company, L-018375-RU, March 15, 1966.

3.0 INPUT ERRORS, cont'd

3.5 Error Employed for Moon Radius

3.5.1 Introduction

The moon radius error causes latitude and longitude uncertainty in the photo border points and error for the camera axis intercept for non-zero tilt angle, the angle between the camera axis and nadir. Although the determination of moon-radius uncertainty is a task beyond the scope of this study, some insight is available, leading to a reasonable estimate of the error.

3.5.2 Moon Radius Error Estimation

A number of studies suggest R_m, the moon radius, is approximately 2 km less (for various regions of the moon) than the value 1738.09 km often employed. These studies involve Lunar Orbiter photo data, Ranger data, and Lunar Orbiter V/H data. Reference 1, using checkpoint data from five Lunar Orbiter missions, indicates a reduction in R_m to 1736.1 km.

The moon radius uncertainty employed in this study is taken as $\pm$ 1.2 km (3σ), giving limits of $1738.09 \leq R_m \leq 1735.7$ km; σ_{R_m} used is therefore 0.4 km.

It is noted that the error uncertainty introduced in the photo points is virtually insensitive to nominal R_m, being dependent upon R_m uncertainty. Also, the moon-radius uncertainty is generally not a large contributor to the total photo error.

3.0 INPUT ERRORS, cont'd

3.5.3 References

1. The Boeing Company Document D2-100814-1, Lunar Orbiter Photo Site Accuracy Analysis - Final Report - Photo Site Analysis.

4.0 COMPUTER PROGRAMS AND PROCEDURES

4.1 Introduction

A 7094 computer program designated PERVAL is designed to perturb eleven EVAL Program nominal input error-producing parameters to obtain the sensitivities of nine photo frame locations examined to the eleven error sources; these sources are

- x, y, z } spacecraft position vector components, selenocentric, mean, 1950.0,
- $\dot{x}$, $\dot{y}$, $\dot{z}$ } spacecraft velocity vector components, selenocentric, mean, 1950.0,
- roll, pitch, yaw } maneuver angles pertinent to photo frame of interest,
- cot — camera on-time of frame of interest, and
- R_m — moon radius.

This program may accommodate stacked cases (photo frames) for the mission of interest; the PERVAL output is in Fortran 2 language, and written on tape (designation C-2). The auxiliary program TCON converts the C-2 tape to Fortran 4 language for use on the 1108 computer, yielding an A-4 (designation) tape. The tapes are stored at the Boeing Computer Center, both the A-4 and its corresponding C-2 tapes being retained in the event of loss or damage to the A-4 tape. An average of approximately six frame cases for a given mission were put on each tape.

The 1108 ERROR Program obtains the photo frame errors by performing the multiplication of the sensitivity matrix (of photo frame parameters to EVAL input error-producing parameters), times the covariance matrix of EVAL input parameters, times the aforesaid sensitivity matrix transposed. The total photo errors are presented for each of the nine points examined in the frame of interest, along with the component navigation, attitude, camera on-time, and moon-radius error contributions. Also given for each of the nine points for the total errors are the eigenvalues, associated rotation angle, and correlation coefficient.

4.2 Tape Checks

Checks on the validity of the stored C-2 and A-4 tapes were made as follows: when

4.0 COMPUTER PROGRAMS AND PROCEDURES, cont'd

4.2 Tape Checks, cont'd

the 7094 PERVAL Program is operated to obtain tape C-2, the nominal photo frame locations, both telephoto (T) and wide-angle (W), on the computer printout are checked against the postmission photo support data results (references 1 to 5); this is done as the postmission EVAL nominals were employed with negligible error to obtain the sensitivity (T) and (W) matrices. This step is a tentative check on tape C-2.

A definitive check on the C-2 tape is obtained as follows: in operating the TCON Program, the first of a number of stacked cases has the 44 EVAL photo border points and other data printed out for the nominal situation for both (T) and (W) lenses; this check is assumed applicable to all stacked cases on the tape.

To check the A-4 tape, an 1108 (ERROR Program) run is made for the first case stacked, noting the errors(and the photo nominals and perturbations - - which are also printed out) for the nine frame points examined; this check is assumed applicable to all cases stacked on the tape.

4.3 Computer Program Description

A Coordination Sheet from Mathematical Services Unit 2-2641 is included in this subsection giving details of the computer programs PERVAL and ERROR. The principal distinction regarding the ERROR Program for this study depends upon the initial orientation of the spacecraft, from which the desired attitude is attained for the frame of interest:

> For celestial alignment, for frames of Missions I, II, III, V, and the first frame of a Mission IV maneuver series, the flagword card is
>
> 1, -1, -1, 18 (4I10 format);
>
> where a maneuver is initiated from a non-standard attitude, as for the second and additional frames in a Mission IV maneuver series, the flagword card is
>
> 1, -1, -N_o, 18 (4I10 format),
>
> where N_o is the number of maneuvers in the series including the one based upon celestial alignment.

The order of the input cards for each frame is

> Title card
> Flagword card (4I10 format)
> Navigation covariance matrix, 12 cards (8X, 3E16.8, 24X format) punched output from the orbit-determination program

4.0 COMPUTER PROGRAMS AND PROCEDURES, cont'd

4.3 Computer Program Description, cont'd

∇_t, ∇_{R_m} card (6F10.5 format)

Data reduction error card (3F24.7 format)
Telemetry error card (3F24.7 format)
Rate integrating mode error card (3F24.7 format)
Maneuver duration card (3F24.7 format)
Factor card (3F24.7 format)
Camera axis-to-spacecraft misalignment card for (W) lens (3F24.7 format)
Camera axis-to-spacecraft misalignment card for (T) lens (3F24.7 format)
Maneuver angle card (3F24.7 format)

The A-4 tape number card is the second card in the deck, following the job number card, and has the following format

∇RX∇ASG∇A=1234
COLUMN 1 ↑ (SPACE) ↑ ↑ A4 TAPE NO.

The Mathematical Services Unit Coordination Sheet follows.

COORDINATION SHEET

TO H. J. Kuhls

NO. 2-2641-1-035 Revised

ITEM NO.

CC W. R. Burr, J. P. Dyer, L. B. Eldrenkamp, T. J. Hansen, W. G. Moyers, D. VanZandt

DATE Feb. 26, 1968
Oct. 10, 1968 rev

MODEL UPS

FROM S. D. Boerner, R. W. Myers

GROUP INDEX

SUBJECT 7094 PERVAL Program and 1108 ERROR Program Operation

REFERENCE 1. Computing Work Authorization No. 1YL-D1C

INTRODUCTION Reference 1 specifies changes to be made to EVAL (Evaluation Program for photosite locations), a standard program for Lunar Orbiter missions. These changes have been made, resulting in a new 7094 program PERVAL (PERturb EVAL). This memorandum will outline the operation of this program on the 7094, and describe the operation of an additional program required to expedite the error analysis (of the improved postmission photo support study), the 1108 ERROR Program.

I. 7094 PERVAL Program

PERVAL is run under the LOS system on the 7094, with the same deck setup as EVAL with the following exceptions:

1. PERVAL will produce 12 times as much output as EVAL, i.e., it will produce 12 EVAL cases: the normal EVAL case and 11 perturbed cases, perturbing X, Y, Z, DX, DY, DZ, roll, pitch, yaw, camera-on-time, and moon radius in that order.
2. PERVAL will have multicase capability: each set of GENI and EVAL inputs can be followed by another such set, and execution terminated by reading through an end-of-file.
3. PERVAL cannot produce any plots of its output (TINY = 0 always), and only one camera-on-time can be given per case.
4. PERVAL will use a short flight tape, saving considerable time (approximately 5 minutes) for single cases. Run time will be about 10 minutes per case.
5. The PERVAL output will be written on tape and converted to 1108 format by a standard tape conversion routine TCON, which may be run either seperately or immediately after PERVAL
6. The deck setup for running PERVAL in the production mode is as follows:

   a) LOS and IBSYS control cards
   b) JPTRAJ source deck
   c) (4 card
   d) COMAND.D = INITIALIZE
   e) (0 card
   f) Ephemeris cards for current mission
   g) (4 card
   h) Eval inputs (nominal)
   i) (0 card
   j) c) - i) for all frames

II. 1108 ERROR Program

The ERROR Program processes the tape produced by TCON, generating sensitivity and covariance matrices as described in reference 1. Generally speaking, this program handles several cases (frames) stacked on the tape, combining these data with card input similarly stacked consisting of a navigation covariance matrix, vehicle maneuver parameters and errors, camera-on-time error, and moon radius error, to produce its output.

The input tape is medium or high density, mounted on logical unit A, and rewound.

The output consists of the total errors for both telephoto (T) and wide-angle (W) lenses (and the contributions due to navigation, attitude, camera-on-time, and moon radius errors) for nine points in the photo frame: the camera axis (designated point 0), and EVAL border points 1 (corner point), 6 (between corners approximately midway), 12 (corner), 17, 23(corner), 28, 34 (corner), and 39. Also given for the nine 2x2 points for the total error are the eigenvalues, associated rotation angle, and correlation coefficient.

Input cards are as follows:

a. Title card (72 column with case title)

b. Flagword card controlling parameters for optional inputs as illustrated below: (Format 4I10)

Flagword 1 regards the sensitivity matrix:

3 gives 1108 input tape dump
2 means skip this case on tape (read next title and flagword cards)
1 reads inputs from tape
0 reads card input (no tape)
-1 use previous case values

Flagwords 2 and 3 regard card input possibilities:

See Figure 1 below where
M = maneuver inputs (fortran names DR, LST, RIM, TM, FAC, DON, CON, and AN, described later in the memo),
N_o = number of maneuvers in a series beginning with celestial alignment,
N = navigation covariance matrix,
R_T = attitude covariance matrix for telephoto lens,
R_W = attitude covariance matrix for wide-angle lens,
DT = 1σ camera-on-time error,
DRM = 1σ moon radius error

FLAGWORD 2 \ FLAGWORD 3	$-N_o$	0	1
1	M	N, R_T, R_W	R_T, R_W
0	M	R_T, R_W	R_T, R_W
-1	N, DT, DRM, M	N, DT, DRM	N, DT, DRM, R_T
-2	N, DT, DRM, DT, M	N, DT, DRM, DT	N, DT, DRM, DT, R_T
	N, DT, DRM, DT	N, DT, DRM, DT	N, DT, DRM, DT, R_W

FORMAT
N IS 8X, 3E16.8, 24X
R IS 8F10.5
DT AND DRM ARE 6F10.5
M IS 3F24.7

Figure 1, Flagword 2 and 3 Possibilities

II. 1108 ERROR Program, cont'd

Input cards, cont'd

b. Flagword card, cont'd

Flagword 4 regards the number of frame points for which the case is to be run, being 2 x (number of frame points). Normally this will be done for the nine points mentioned, giving a flagword of 18, though capability exists for up to the 44 points generated by EVAL (plus the camera axis), since this information is available to the program from PERVAL.

A flagword of (1, -1, -1, 18) is common, being used for frames for which the initial orientation of the spacecraft is based upon celestial alignment: flagword 1 reads inputs from tape, flagword 3 corresponds to $N_o = 1$ (so that flagword 3 is -1), and flagword 2 being -1 requires inputs of navigation covariance matrix N, camera on-time 1σ error DT, moon-radius 1σ error DRM, and maneuver inputs M, discussed below.

Flagwords 1, 2, 3, and 4 are punched on the data card as shown in Figure 2 below.

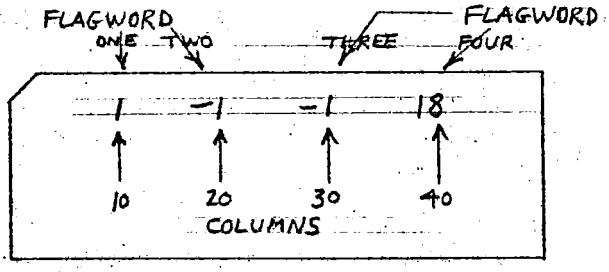


Figure 2, Flagword Card Format, 4I10

c. Navigation Covariance Cards

Twelve cards are required, utilizing format 8X, 3E16.8, 24X; (RIGHT ADJUSTED) output is punched from the orbit determination program; units are km^2, $(km/sec)^2$.

d. DT, DRM Card (Fortran Variables)

Format is 6F10.5 for these 1σ errors; seconds and km, respectively.

e. Data Reduction Error Card (DR Fortran Variable)

Format is 3F24.10 for this 3σ error; roll, pitch, yaw order on card; deg.

f. Telemetry Limit-Cycle Error Card (LST Fortran Variable)

Format is 3F24.10 for this 3σ error; may be combined(rss'd) with DR; rpy order; degrees.

g. Rate Integrating Mode Drift Error Card (RIM Fortran Variable)

Format is 3F24.10 for this 3σ error; roll, pitch, yaw order on card; deg.

h. Maneuver Duration Card (T Fortran Variable)

Format is 3F24.10 for this 3σ error; roll, pitch, yaw order on card; deg.

i. Factor Card (F Fortran Variable)

Format is 3F24.10 for this quantity; roll, pitch, yaw order on card.

j. Camera-axis-to-spacecraft misalignment for wide-angle lens (DON Fortran Var.)

Format is 3F24.10 for this quantity; roll, pitch, yaw order on card; deg., 1σ

j. Camera-axis-to-spacecraft misalignment for telephoto lens (CON Fortran Var.)

Format is 3F24.10 for this error; roll, pitch, yaw order on card; deg., 1σ

II. 1108 ERROR Program, cont'd

Input cards, cont'd

1. Maneuver Angle Card (AN Fortran Variable)

Format is 3F24.10 for this quantity; roll, pitch, yaw order; degrees.

The input deck setup is shown in Figure 3 below:

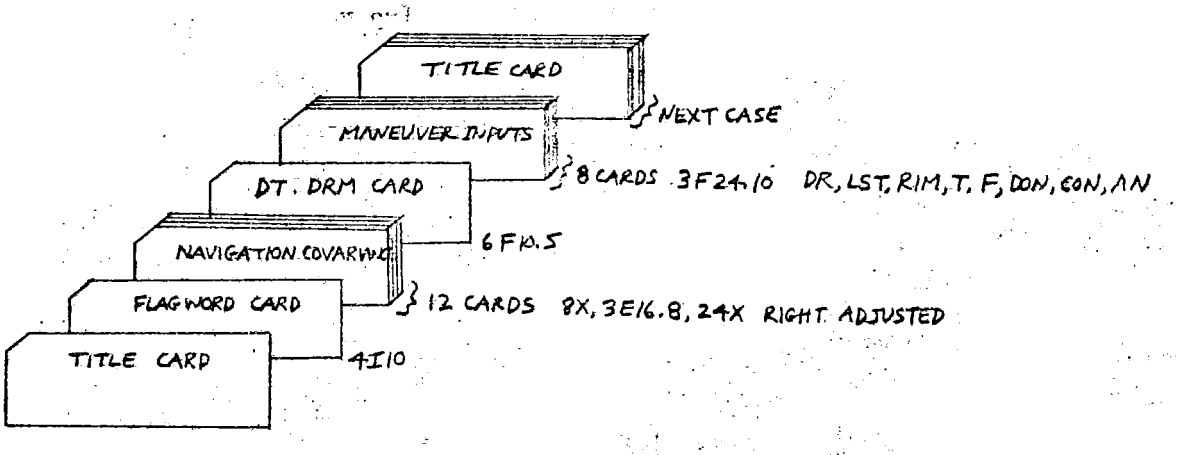


Figure 3, Input Deck Setup for Single Maneuver Cases

The complete deck setup is shown below in Figure 4.

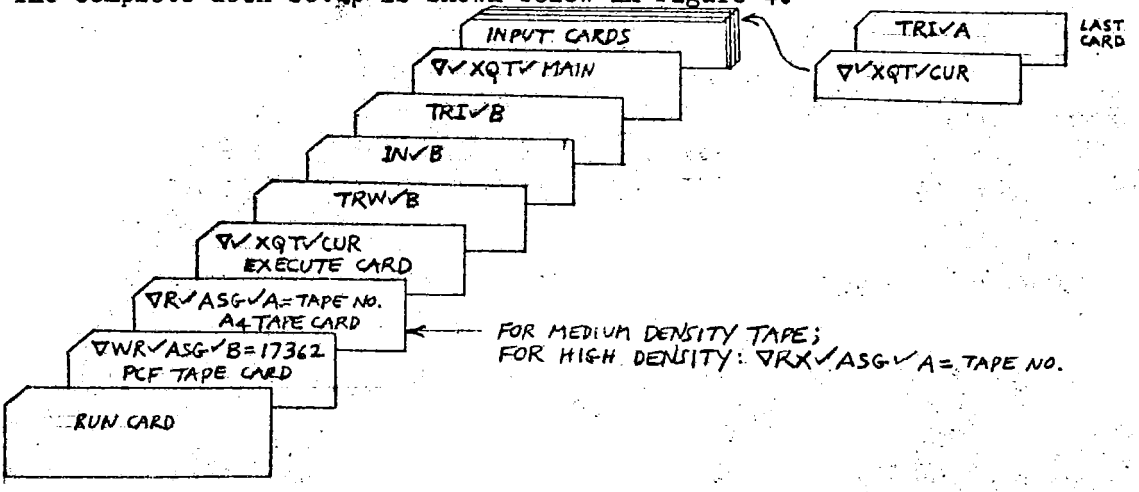


Figure 4, Complete Deck Setup for ERROR Program

Further information regarding the PERVAL and ERROR Programs is given in the attached Appendices.

Prepared by: Stephen D. Boerner, Robert W. Myers

Approved by: H. J. Kuhls

COORDINATION SHEET APPENDIX

1108 ERROR PROGRAM LISTING

```
-  FOR MAIN, MAIN/SOURCE
       MAIN PROGRAM
        DIMENSION T(11,11),S(11,44),P(44,44),SS(11,44),T2(11,11),TIL(4)
        COMMON/FLAG/LAG
        DIMENSION LAG(4)
        DIMENSION TITLE(12)
        DATA(TIL(I),I=1,4)/ 6HNAVIGA     ,6HR MAT
       1,3HDT ,3HDRM/
15      J=1

C      READ TITLE CARD FOR THIS CASE AND FLAGWORDS

        READ(5,3000)TITLE
        READ(5,2000)LAG
 2000 FORMAT(4I10)
 3000 FORMAT(12A6)
C      FLAGWORD FOUR IS TWICE THE NUMBER OF POINTS WHOSE
C      LATITUDE AND LONGITUDE MAKE UP THE COVARIACE MATRIX
        NC=LAG(4)
        IF(LAG(1).GE.2) GO TO 77
  26    IF(LAG(1))80,31,32
  32    CONTINUE

C      SUBROUTINE IN READS MANUEVER INPUT CARDS AND CALCULATES ROTATION MATRIX

  77    CALL IN(NC,NK)
        SKIP THIS CASE ON INPUT TAPE

        IF(LAG(1).GE.2)GO TO 15
  30    CALLFSS(S,3,NC)
        LAG(1)=0
        GO TO 80

C      THIS SECTION CONTROLS TELEPHOTO AND WIDEANGLE CASE(J=1,2)

  31    CALL FSS(S,J,NC)
  80    CALL EM(T,J)

C      THIS LOOP ZEROS OUT SELECTED PORTIONS OF NAVIGATION
        DO 10 KK=1,5
 1000   FORMAT(1H0,50X,A6 ///////)
        CALL STORE(S,SS,NC*11)
C      MATRIX T(CALCULATED IN EM) FOR COVARIANCE MATRIX OF ERRORS (P)
        CALL STORE(T,T2,121)
        IF(KK.NE.1)GO TO 17
        WRITE(6,3500)TITLE
        GO TO (18,19),J
  18    WRITE(6,5500)
        GO TO 17
  19    WRITE(6,5000)
  17    IF(KK.EQ.1)GO TO 29
        I=KK-1
        WRITE(6,1000)TIL(I)
        CALL ZERO(T2,I)
  29    CALLCAN(SS,T2,P,44,11)
```

```
      CALL BUT(SS,T2,P,KK,J)
   10 CONTINUE
20       J=J+1
C     PROCESS NEXT CASE J=3
       IF(J.EQ.3)GO TO 15
       GO TO 26
5000   FORMAT(1H1,40X,15H TELEPHOTO LENS //////)
5500   FORMAT(1H0,40X,16H WIDE ANGLE LENS ////////)
 3500 FORMAT(1H1,10X,12A6)
       END
```

MAIN

```
   FOR IN, IN/SOURCE
      SUBROUTINE IN(NC,NK )
      DIMENSION E9(11,176),LL(9),E8(12,4,45),
     1XLOC(12),XLAC(12),ROT(3),STV1(11,13),VEC2(11),VEC(11)
      DIMENSION LAG(4)
      DIMENSION E1(176)
      DOUBLE PRECISION E1,E9
      COMMON/FLAG/LAG
      COMMON E1,E9,VEC ,VEC2
      DATA LL/0,1,6,12,17,23,28,34,39/
        COMMON/IO/X
      IF(LAG(1).GE.2)GO TO 69
      NP=LAG(4)
      NC=LAG(4)
      DO 15 J=1,12
      READ(1)X,ROT

C       READ INPUT TAPE 44 LAT AND LONG FOR HIGH AND LOW RESOLUTION
C       FOR EACH OF 11 VALUES PERTURBED AND NOMINAL VALUE
      READ(1)(E8(J,1,L+1),L=1,44)
      READ(1)(E8(J,2,L+1),L=1,44)
      READ(1)(E8(J,3,L+1),L=1,44)
      READ(1)(E8(J,4,L+1),L=1,44)
   15 READ(1)(STV1(I,J),I=1,11),XLOC(J),XLAC(J)

C       XLOC AND XLAC ARE CAMERA AXIS INTERSECTION STV-STATE VECTOR
      DO 20 J=1,12
      E8(J,1,1)=XLOC(J)
      E8(J,2,1)=XLAC(J)
      E8(J,3,1)=XLOC(J)
20    E8(J,4,1)=XLAC(J)
      NP=NP/2
      DO 30 M=1,4
      DO 30 K=2,12                                                    IN
      DO 30 J=1,NP
      L=LL(J)+1
      MM=M/2.01
      JJ=(MM    )*88+(J-1)*2+MOD(M   ,2)+1
      E9(K-1,JJ)=E8(K,M,L)
30    E1(JJ)=E8(1,M,L)
      DO 17 I=1,11
      VEC2(I)=STV1(I,I)
17    VEC(I)=STV1(I,12)
1000  FORMAT(11E10.3)
      RETURN
69    LLG=LAG(1)*72-72
      IF(LAG(2).NE.0)LLG=LAG(2)*72+LAG(3)
      CALL NTRAN(1,7,LLG,22)
      WRITE(6,1515)
1515  FORMAT(1H1,17HSKIPPED THIS CASE)
      RETURN
      END
```

```
  FOR BUT,BUT/SOURCE
        SUBROUTINE BUT(S,M,P,KK,JJ)

C     SUBROUTINE BUT DOES ALL OUTPUT

        PARAMETER NK=176
        DOUBLE PRECISION EVAL39,EVAL1
        DIMENSION M(11,11),EVAL1(NK),VEC(11),EVAL39(11,NK),
       1P(44,44),VEC2(11),S(11,44),TIT(11),SS(1,44)
        DIMENSION LAG(4)
         DIMENSION O(2,44)
        DIMENSION AN(3)
        DIMENSIONLL(18)
        DIMENSION VAR(5)
          DIMENSION EXD(3,3)  ,EXE(3,3)
        DIMENSION EX(3,3),IOB(3,3),R(3,3),IOC(3,3),EXC(3,3)
        DIMENSION TW(2)
        DIMENSION DR(3),LST(3),RIM(3),TM(3),CON(3) ,FAC(3)
        COMMON/BLOCK B/DR,LST,RIM,TM,FAC,CON,AN,EX,IOB, IOC,EXC,EXD,EXE
        COMMON EVAL1,EVAL39,VEC,VEC2
        COMMON/FLAG/LAG
        COMMON/BLOCK/R
        DATA(TIT(I),I=1,11)/1HX,1HY,1HZ,2HDX,2HDY,
       12HDZ,4HROLL,5HPITCH,3HYAW,2HDT,3HDRM/
        DATA TW/1HW,1HT/
        DATA VAR/5HTOTAL,5HNAVIG,3HATT,4HTIME,2HRM/
        DATA LL/0,0,1,1,6,6,12,12,17,17,23,23,28,28,34,34,39,39/
        NC=LAG(4)
        DO 20 I=1,NC
   20   CALL SUMSQ(P(I,I),1,SS(I,1))
        WRITE(6,8000)VAR(KK),TW(JJ)
        J1=1
        J3=1
        J2=NC/2
        J4=NC/2
C.    CALCULATE EIGENVALUES

         CALL  EIVAL(P,J1,J2,J3,J4,0)
        WRITE(6,6600)(LL(I),I=J1,J2)
        WRITE(6,6000)(LL(J),(P(I,J),I=J1,J2),J=J3,J4)
         WRITE   (6,6200)((O(I,J),J=J1,J2),I=1,2)
        WRITE(6,1400)(SS(I,1),I=J1,J2)
        J1=J2+1
        J2=NC
        J3=J4+1
        J4=NC
        WRITE(6,6600)(LL(I),I=J1,J2)
        WRITE(6,6000)(LL(J),(P(I,J),I=J1,J2),J=J3,J4)
         WRITE   (6,6200)((O(I,J),J=J1,J2),I=1,2)
        WRITE(6,1400)(SS(I,1),I=J1,J2)
        WRITE(6,6968)
 6968 FORMAT(///)
        J1=1
        J2=NC/2
        WRITE(6,6000)(LL(J),(P(I,J),I=J1,J2),J=J3,J4)
```

```
 400  FORMAT (// 20H SQR ROOTS OF DIAG    ,9E12.7)
      IF(KK.NE.1)RETURN

C     WRITE OUT MANEUVER INPUTS AND CALCULATIONS
      WRITE(6,1717)DR,LST,RIM,TM,FAC,CON,AN
 1717 FORMAT(1H1,30X,25HCALCULATION OF R MATRIX
     1//5H DR= 3E15.7/5H LST=3E15.7/5H RIM=3E15.7/
     25H TM =3E15.7/5H FAC=3E15.7/5H CON=3E15.7/5H AN= 3E15.7//      )
      WRITE(6,1515)EXE,EXD,EXC,EX,IOB,IOC,R
 1515  FORMAT(//10X,,10HEX1 MATRIX/3(3E12.7/),/10X,20H EX2 WITHOUT FACTORS/3(3E1
     URS/3(3E12.7/)
     U      /10X,10HEX2 MATRIX/3(3E12.7/)/10X,8HEX TOTAL/3(3E12.7/)
     1/10X,9HIO MATRIX/3(3E12.7/),
     2/10X,15HIO WITH FACTORS/3(3E12.7/),/10X,8HR MATRIX/3(3E12.7/))
      WRITE(6,6500)TIT,M
      WRITE(6,2222)TIT
 2222 FORMAT(1H1,20X,22HVALUES OF THE NOMINAL 33HAFTER PERTURBING THE EV
     1AL INPUTS /,4X,11(A6,6X))
      DO 32 I=1,NC
   32 WRITE(6,6800)EVAL1(I),(EVAL2(J,I),J=1,11)
      DO 30 I=1,11
      WRITE(6,6900)(TIT(I),VEC(I),VEC2(I))
   30 CONTINUE
      WRITE(6,7000)TW(JJ),((S(J,I),J=1,11),I=1,NC)
 6900 FORMAT( 5X,A6,19HWAS PERTURBED FROM ,F20.10,5X, 3HTO ,F20.10)
 7000 FORMAT(///////50X,18HSENSITIVITY MATRIX,5X,A6,////(1X,10E12.7,E11.
     26))
 6800 FORMAT(16H THE NOMINAL IS D20.10,/ (1X,10D12.7,D11.6))
 6500 FORMAT(////50X,10HM  MATRIX //4X,11(A6,6X)          /// (1X,10E12.
     27,E11.6))
 1000 FORMAT(///20X,37HTHE SUM OF THE DIAGONAL ELEMENTS IS  ,E12.7///)
 8000 FORMAT(////30X,21HCOVARIANCE MATRIX OF ,A6,6HERRORS,5X,A6)
 6600 FORMAT(///15X,9I12)
 6000 FORMAT(I10,  10X,9E12.7)
 6200  FORMAT(12H EIGENVALUES,8X,9E12.7/10H  BETA,RHO,10X,9E12.7)
      RETURN
      END
```

```
   FOR EX,EX/SOURCE
       SUBROUTINE EY( K)

C      EX CALCULATES THE EXECUTION MATRIX
C      INPUTS ARE DR,LST,RIM,TM,FAC,CON(WIDE AN),CON(TEL) MANEUVER ANGLES

        COMMON/BLOCK/R
       DIMENSION IO(3,3),R(3,3),EXC(3,3),IOC(3,3) ,EXD(3,3)                EY
       DIMENSION AN(3),EX(3,3)
       DIMENSION EXE(3,3)
       DIMENSION DR(3),LST(3),RIM(3),TM(3),CON(3) ,FAC(3),DON(3)
       DIMENSION LAG(4)
       DIMENSION IOB(3,3)
        DIMENSION BUFF(300)
       COMMON/BLOCK B/DR,LST,RIM,TM,FAC,CON,AN,EX,IOB, IOC,EXC,EXD,EXE
       COMMON/FLAG/LAG
       REAL IO,IOB,IOC
       REAL LST
       DATA IO/.000671,0.,0.,0.,.000153,0.,0.,0.,.000153/
       LG=LAG(3)
       DO 69 J=1,3
       DO 69 I=1,3
69       IOB(I,J) = IO(I,J)
       REWIND 8                                                            1
       IF(K.EQ.2)GO TO 19
       II=-LG*24                                                           2
       READ(8,1717)(BUFF(I),I=1,II)
       WRITE(8,1717)BUFF                                                   4
  19   REWIND 8                                                            5
51       CONTINUE
   50 CONTINUE
       READ(8,1717)DR,LST,RIM,TM,FAC,CON,DON    ,AN
        IF(K.EQ.2) CALL SWITCH(CON,DON,1,3)
 1717 FORMAT(3F24.10)
 18    NP=9
       DO 10 I=1,3
       J=MOD(I,3)+1
       JJ=MOD(J,3)+1
       JK=(12-I-.001)/3
   10 EX(I,I)=(DR(I)/3)**2+(LST(I)*.577)**2+(RIM(I)/3)**2
      2+(TM(JJ)*1.11E-4)**2+(TM(JK)*3.13E-5)**2
      I+(TM(J)*1.11E-4)**2+CON(I)**2
       EX(1,2)=(TM(3)*3.13E-5)**2+(TM(3)*1.11E-4)**2
       EX(2,1)=EX(1,2)
       EX(1,3)=(TM(2)*1.11E-4)**2+CON(1)*CON(3)
       EX(3,1)=EX(1,3)
       EX(2,3)=(TM(1)*1.11E-4)**2
       EX(3,2)=EX(2,3)
         DO 20 I=1,3
         DO 20 J=1,3
       IO(I,J)=IO(I,J)*FAC(I)*FAC(J)
       IOC(I,J)=IO(I,J)
       EXD(I,J)=EX(I,J)
        EX(I,J) =EX(I,J)*FAC(I)*FA C(J)
   20  EXC(I,J)=EX(I,J)
```

```
      DO 15 I=1,3
15    EX(I,I) =EX(I,I)
     1+(TM(I)*1.67E-4)**2+(.001*AN(I))**2
     3+(.0144)**2+(.00635)**2
      DO 17 I=1,3
      DO 17 J=1,3
      EXE(I,J)=EX(I,J)-EXC(I,J)
      R(I,J) =IO(I,J)+EX(I,J)
17      IO(I,J)=IOB(I,J)
 1313 FORMAT(10X,3E12.7)
      IF(LAG(3).GE.-1)GO TO 30
      WRITE(6,1313)EX,IO ,R
      DO 40 I=1,3
      DO 40 J=1,3
   40 IO(I,J)= R(I,J)
      LAG(3)=LAG(3)+1
      GO TO 51
   30 CONTINUE
      LAG(3)=LG
      RETURN
       END
```

```
C   FOR ESS,ESS/SOURCE
      SUBROUTINE ESS(S,K,NC)
C     ESS CALCULATES COVARIANCE MATRIX OF PERTURBATIONS

        DOUBLE PRECISION  E 9,E1
      DIMENSION LAG(4)
      DIMENSION E1(176),E9(11,176),VEC(11),VEC2(11),S(11,44)
      COMMON E1,E9,VEC,VEC2
      COMMON/FLAG/LAG
      NC=LAG(4)
      NK=NC+2                                                          ESS
      GO TO (29,28,27),K
29     READ(5,2000) VEC,VEC2
       READ(5,2500)          ((E    9(J,I),I=1,NK),J=1,11),(E1(I),I=1,NK)
      GO TO 27
   28 IF(NC.EQ.4)GO TO 30
      CALL SWITCH(E1(1),E1(89),1,88)
      CALL SWITCH(E9(1,1),E9(1 ,89),22,88)
      GO TO 27
   30 CALL SWITCH(E9(1,3),E9(1,5),22,2)
      CALL SWITCH(E1(3),E1(5),1,4)
 2500 FORMAT    (8D10.8)
 2000 FORMAT    ( 4F20.10)
27     CALL FND(S,E    9,E   1,NK,VEC,VEC2)
      RETURN
      END
```

```
C FOR EIVAL,EIVAL/SOURCE
C       CALCULATE EIGENVALUES FOR LAT 8 LONG FOR EACH POINT,BETA,RHO

        SUBROUTINE EIVAL(P,J1,J2,J3,J4,O)
        DIMENSION P(44,44),Q(6,6),EIGVAL(2)
        DIMENSION O(2,44)
          DO 10 I=1,9
         I1=2*I+J1 -2
         I2=2*I+1+J3-2
         Q(1,1) =P(I1,I1)
         Q(1,2) =P(I1,I2)
         Q(2,1) =P(I2,I1)
         Q(2,2) =P(I2,I2)
         CALL    EIGEN(EIGVAL,THETA,Q)
         O(1,I1 )=EIGVAL(1)
         O(1,I2 )=EIGVAL(2)
         O(2,I1 )=THETA*180.0/3.1415926
         O(2,I2 )=(P(I1,I2)*P(I2,I1))/(P(I1,I1)*P(I2,I2))
10      O(2,I2)=SIGN(SQRT(ABS(O(2,I2))),P(I1,I2))
          RETURN
          END
```

```
FOR EIGEN
      SUBROUTINE EIGEN(EIGVAL,THETA,Q)                                  MP102320
      DIMENSION Q(6,6),EIGVAL(2)                                        MP102330
      SQT(X)=SQRT(X)
      P=Q(1,1)                                                          MP102340
      R=Q(2,2)                                                          MP102350
      S=(Q(1,2)+Q(2,1))*0.5                                             MP102360
      DIS=SQT((P-R)*(P-R)+4.0*S*S)                                      MP102370
      COE=P+R                                                           MP102380
      EIGVAL(1)=0.5*(COE+DIS)                                           MP102390
      EIGVAL(2)=0.5*(COE-DIS)                                           MP102400
      IF(S)1,2,1                                                        MP102410
    2 IF(P-R)1,3,1                                                      MP102420
    1 CONTINUE                                                          MP102430
      THETA=0.5*ATN1F(2.0*S,P-R)                                        MP102440
      IF(THETA)10,20,20                                                 MP102450
   10 THETA=6.28318531+THETA                                            MP102460
   20 RETURN                                                            MP102470
    3 THETA=0.0                                                         MP102480
      GO TO 20                                                          MP102490
      END                                                               MP102500
```

```
FOR  ATN1
      FUNCTION ATN1F(X,Y)
      ATN1F = ATAN2(X,Y)
      RETURN
      END
```

```
      FOR EM,EM/SOURCE
           M IS NAVIGATION MATRIX

            SUBROUTINE EM(M,K)
            DIMENSION M(11,11),R(3,3),N(6,6)
            DIMENSION LAG(4)
            COMMON/FLAG/LAG
            COMMON/BLOCK/R
            REAL M,N
            DATA DT/.0577/,DRM/.4/
            IF(K.EQ.2)GO TO 99
            IF(LAG(2).EQ.-1)READ(5,1000)N,DT,DRM

C             CONTROL FOR READING N, DELTATIME,DELTARADIUSMOON
            IF(LAG(2).EQ.-2)READ(5,1000)N,DT,DRM,DTW
 1700       FORMAT(13F10.8,I10)
   99       IF(LAG(3)) 150,17,30
 17         IF(LAG(2)) 15,26,18
 18         GO TO(25,26,15),K
 150        CALL EY(K)
            GO TO 15
 25         READ(5,1000) N
  26        READ (5,3000) R
  15        DO 10 I=1,3
            DO 10 J=1,3
  10         M(I+6,J+6)=R(I,J)
   5         DO 20 I=1,6
            DO 20 J=1,6
   20        M(I,J)=N(I,J)
            M(10,10)=DT**2
            M(11,11) =DRM**2
 1000       FORMAT(12(8X,3E16.8/),8F10.7)
 3000       FORMAT ( 8F10.8 /3F10.8,I5)
            RETURN
 30         READ(5,1000)R
            GO TO 15
            END
```

```
   FOR SUB
         SUBROUTINE FND(S,PB,P,N,PT,PTB)

C     FND COMPUTES NOMINAL MINUS PERTURBED OF MOON DEGREES
C       WITH RESPECT TO VARIABLE PERTURBED
          DOUBLE PRECISION  PB,P
        DIMENSION P(N),PB(11,9),PT(11),S(11,44),PTB(11)
        NC=N-2
        DO 10 I=1,NC
        DO 10 J=1,11
        XMP=PB(J,I)-P(I)-IFIX((PB(J,I)-P(I))/180.)*360.
         S (J,I) =-XMP              /(PT(J)-PTB(J))
        IF(P (I).EQ.0)CALL Z1RO(S(1,1 ),I )
        IF(PB(J,I ).EQ.0)CALL Z1RO(S(1,1 ),I )
  10    CONTINUE
        RETURN
         END
```

```
 - FOR Z1RO
         SUBROUTINE Z1RO(A,J)
         DIMENSION A(11,44)
         DO 10 I=1,11
  10     A(I,J)=0
         RETURN
         END
```

```
      FOR TRANS,TRANS/SOURCE
            SUBROUTINE TRAN(A,B,N,M)
            DIMENSION A(N,M),B(M,N)
           DO 10 I=1,N
           DO 10 J=1,M
   10      B(J,I)      = A(I,J)
           RETURN
            END


      FOR CAN,CAN/SOURCE
           SUBROUTINE CAN(A,B,C,N,M)
            DIMENSION A(N, M),B(M,M),C(N,N),D(.11,44),E(44,44)

C           CAN GIVES MATRIX PRODUCT A BY B BY ATRANSPOSE RETURNED INC
           CALL TRAN(A,D,M,N)
            CALLMPPY(D,B,E,N,M,M)
            CALL MPPY(E,A,C,N,M,N)
            RETURN
             END


      FOR MPPY,MPPY/SOURCE
           SUBROUTINE MPPY(A,B,C,N,M,L)
            DIMENSION A(N,M),B(M,L),C(N,L)
           DO 10 I=1,N
           DO 10 J=1,L
            C(I,J) =0.
           DO 10 K=1,M
   10       C(I,J)=C(I,J) +A(I,K)*B(K,J)
           RETURN
           END
```

```
FOR SUMSQ
    SUBROUTINE SUMSQ(A,N,SUM)
    DIMENSION A(N,N)
    SUM=0.
    DO 10 I=1,N
10  SUM=SUM+A(I,I)
    SUM=SQRT(ABS(SUM))
    RETURN
    END
```

```
FOR FUN
    SUBROUTINE FUN(A,I,J)
     DIMENSION A(11,11)
    DO 10 K=1,11
    A(I,K)=0
10  A(J,K)=0
    RETURN
    END
```

```
FOR STORE
    SUBROUTINE STORE(A,B,N)
    DIMENSION A(N),B(N)
      DO 10 I=1,N
10   B(I)=A(I)
     RETURN
     END
```

```
    FOR SWITCH
        SUBROUTINE SWITCH(A,B,N,M)
          DIMENSION A(N,M),B(N,M)
        DO 10 I=1,N
        DO 10 J=1,M
        TEMP=A(I,J)
         A(I,J)=B(I,J)
10       B(I,J)=  TEMP
        RETURN
         END


-   FOR ZERO      ,ZERO/SOURCE
         SUBROUTINE ZERO(A,N)
        DIMENSION A(11,11)
        GO TO  (10,20,30,40) ,N
10      DO 15 I=7,11
         DO 15 J=1,11
15       A(I,J) =0.
        RETURN
20      DO 25 I=1,6
         DO 25 J=10,11
    25  CALL FUN(A,I,J)
        RETURN
30      DO 35 I=1,9
        DO 35    J=11,11
    35  CALL FUN(A,I,J)
        RETURN
40       DO 45 I=1,10
        DO 45 J=1,10
45       A(I,J) =0.
        RETURN
        END
```

```
   FOR CHARET,CHARET/SOURCE
       SUBROUTINE CHARET(A1,A2,N3,$)
       DATA J/0/
         COMMON/IO/X
       J=J+1
        IF(J.GT.1) GO TO 10
          WRITE(6,1000) X,A1,A2,A3
 1000  FOR   MAT(24HTAPE ERROR TRY NEXT FILE,O14,A6,2F18.7)
       CALL NTRAN(1,22,8,1)
  999  RETURN 4
 2000  FOR   MAT(24HTAPE ERROR ABORT         ,O14,A6,2F18.7)
 10      WRITE(6,2000) X,A1,A2,A3
       CALL NTRAN(1,11)
       RETURN
       END
```

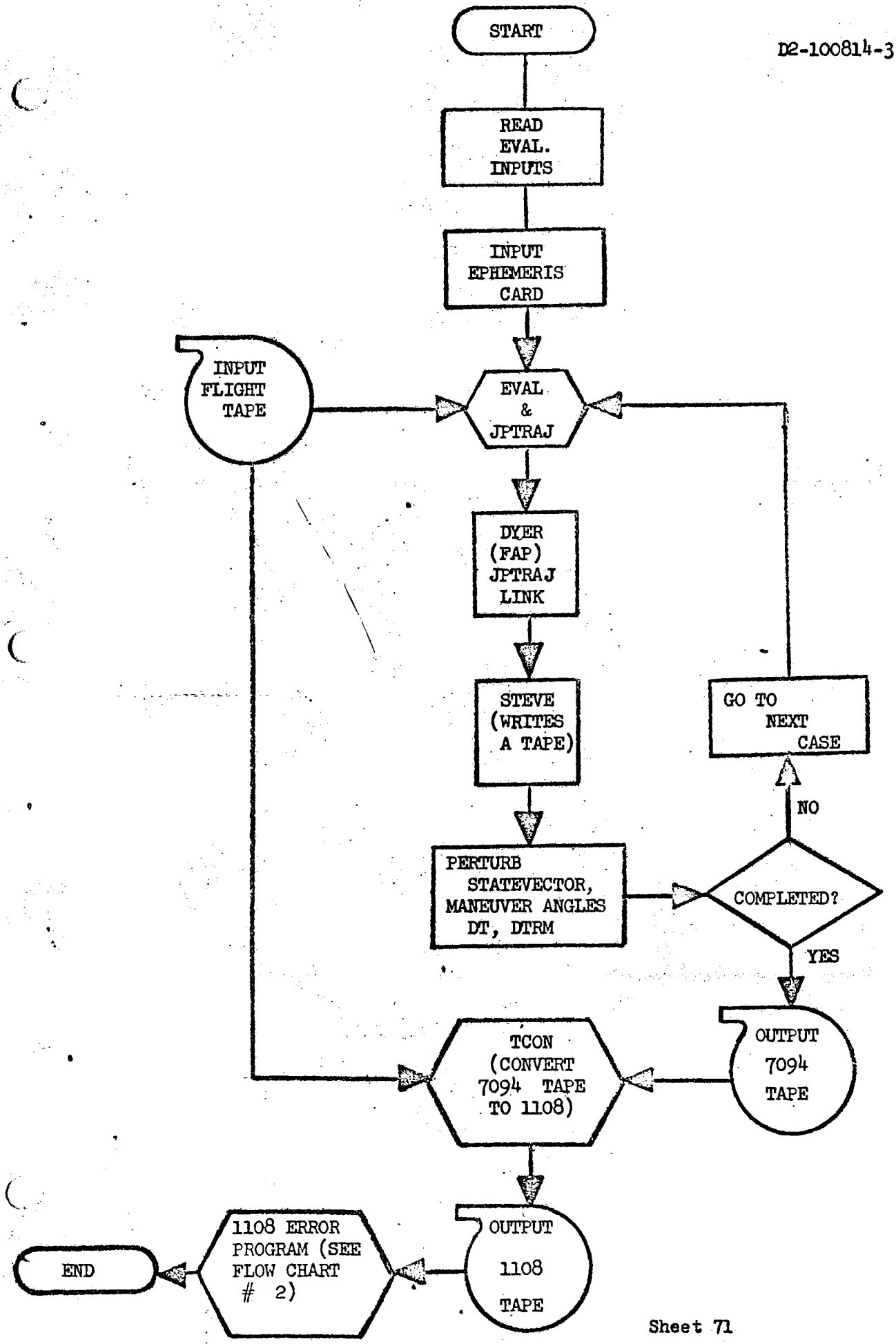
000564

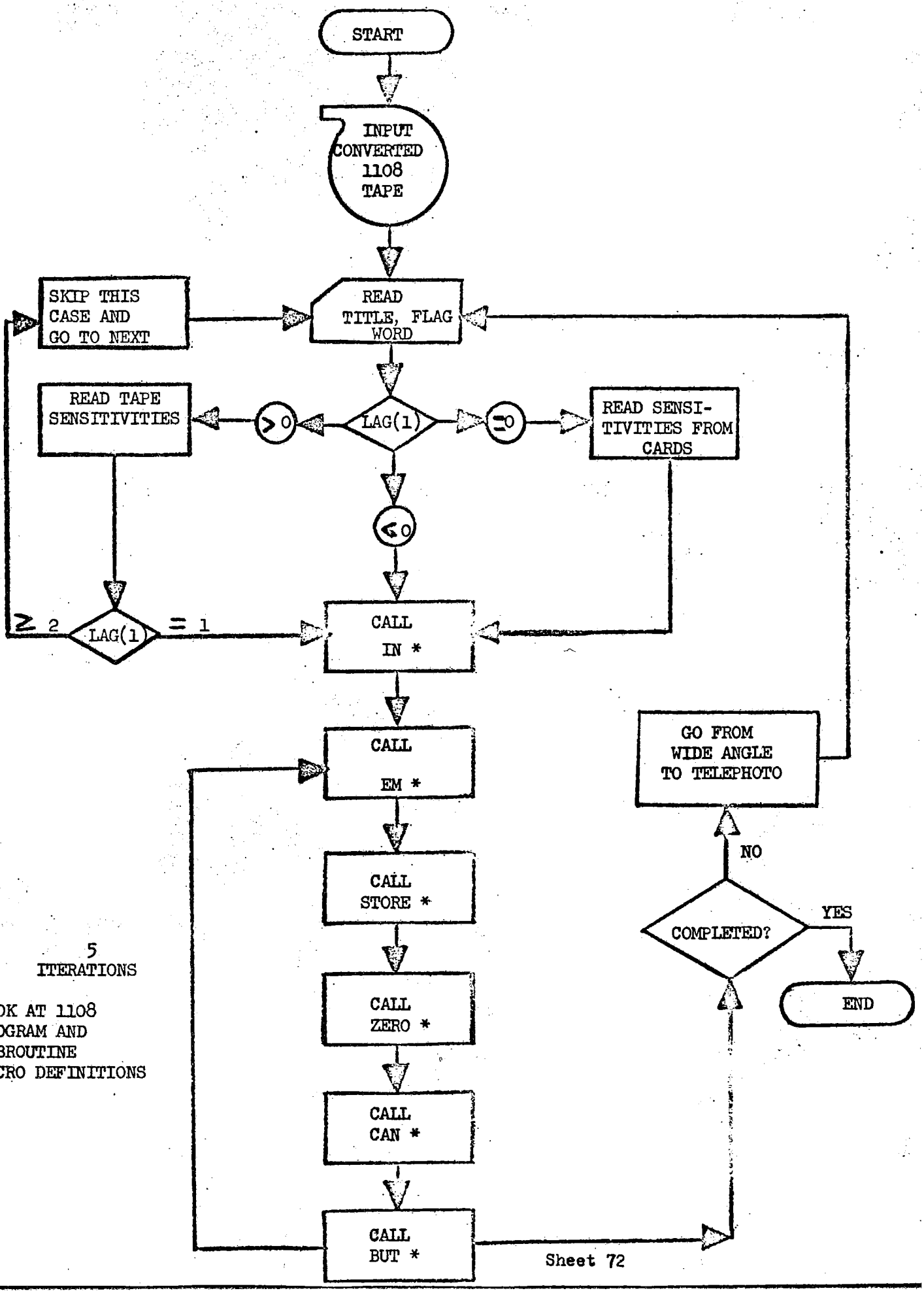
1108 ERROR ANALYSIS PROGRAM AND SUBROUTINE MACRO DEFINITIONS

MAIN	Main program directs execution and loops through EVAL inputs
ESS	Computes Sensitivity matrix
BUT	Prints out results
EM	Computes matrix of navigation, rotation, DT and DRM submatrices.
SUMSQ	Computes root-mean square for output
FUN	Zeros out portions of navigation matrix
FINDIF	Finite differences EVAL inputs for sensitivity matrix
TRANS	Transposes a matrix
EULER	Calculates rotation matrix
CAN	Performs canonical operation ABA^T for inputs A, B matrices
MPPY	Multiplies matrices
IOS	Computes initial orientation matrix, reading in inputs
EX	Computes execution matrix
STORE	Stores matrices for error component analysis
SWITCH	Switches matrices
ZERO	Zeros out matrices
IN	Read off of EVAL tape
EIVAL	Calculates eigen values for latitude and longitude for each point, Beta, RHO
EIGEN	Computes eigen values and rotation angle
ATN1	Arctan routine
FND	Computes finite differences for sensitivity matrix
ZIRO	Routine to handle a case where one pertubation is on Moon and one off
CHARET	Handle tape errors

FLOW CHART #1 OVERALL PICTURE OF PROGRAMS - PERVAL, TCON, & ERROR ANALYSIS

D2-100814-3




START
INPUT CONVERTED 1108 TAPE
READ TITLE, FLAG WORD
SKIP THIS CASE AND GO TO NEXT
LAG(1)
>0
READ TAPE SENSITIVITIES
=0
READ SENSI-TIVITIES FROM CARDS
<0
≥ 2
LAG(1)
= 1
CALL IN *
CALL EM *
CALL STORE *
CALL ZERO *
CALL CAN *
CALL BUT *
GO FROM WIDE ANGLE TO TELEPHOTO
NO
COMPLETED?
YES
END
5 ITERATIONS
* LOOK AT 1108 PROGRAM AND SUBROUTINE MACRO DEFINITIONS

4.0 COMPUTER PROGRAMS AND PROCEDURES, cont'd

4.4 References

1. TBC Document D2-100727-7 (Vol. VII), Lunar Orbiter I, Postmission Photo Supporting Data, 9/29/67.

2. TBC Document D2-100752-7 (Vol. VII), Lunar Orbiter II, Postmission Photo Supporting Data, 9/26/67.

3. TBC Document D2-100753-7 (Vol. VII), Lunar Orbiter III, Postmission Photo Supporting Data, 9/6/67.

4. TBC Document D2-100754-7 (Vol. VII), Lunar Orbiter IV, Postmission Photo Supporting Data, 9/21/67.

5. TBC Document D2-100755-7 (Vol. V), Lunar Orbiter V, Postmission Photo Supporting Data, 11/14/67.

5.0 TABULATION OF RESULTS:

5.1 Introduction

A tabulation sheet for error analysis results has been formulated giving, for the nine photograph frame points of Figure 1, the standard deviation of total error in latitude (μ) and longitude (λ) for both telephoto (T) and wide-angle (W) lenses, and the standard deviations of component errors (navigation, attitude, camera-on-

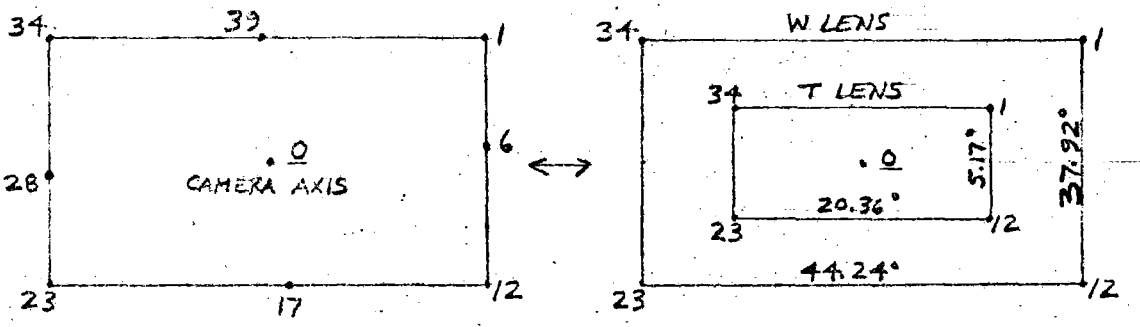


Figure 1, Camera Axis (0) and Eight (EVAL Program) Border Points (1, 6, 12, 17, 23, 28, 34, and 39) Examined for Errors for Each Photograph Frame

time, and moon radius), and the corresponding lunar surface distance for the total error.

In addition, photo parameters of special interest regarding the errors are given, including nominal tilt angle (of the camera axis relative to nadir), spacecraft altitude, and the heading of the (EVAL) border points relative to the orbit; the values are obtained from postmission supporting data documents (given in the reference subsection), as representative values only are required to illustrate the error governing parameters. Also given are the camera axis intercept and nadir latitudes and longitudes, swing angle (see tabulation sheet for explanation), true anomaly, and orbit inclination.

Special notations on the tabulation sheet include the mission target designation for Apollo frames, notice of relatively large attitude maneuvers (where the sum of maneuver angles for all three axes $\geq 120^{\circ}$), and a code giving the number of frames smoothed in obtaining the camera on-time error σ_t (as discussed in Section 3.4); the code is t_n where n is the number of frames smoothed.

Appendix H gives, for each of the nine photo frame points examined, the eigenvalues, associated rotation angle (relative to the latitude and longitude error axes), and

5.0 TABULATION OF RESULTS, cont'd

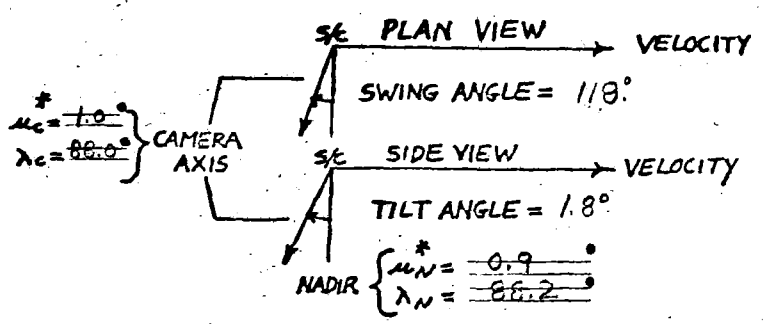
5.1 Introduction, cont'd

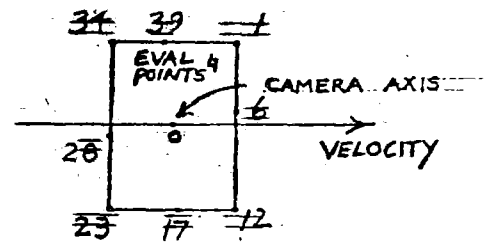
correlation coefficient for the total errors.

5.2 Tabulations

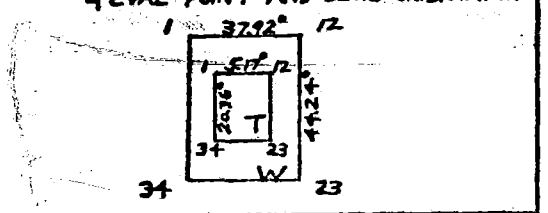
The tabulation of results for each frame examined for error analysis is given in this subsection.

ERROR ANALYSIS RESULTS MISSION I FRAME 12





S/C ALTITUDE = 211.6 KM
TRUE ANOMALY = 352 °
INCLINATION ≈ 11.5 °
NOTE: t.16



TELEPHOTO LENS, T

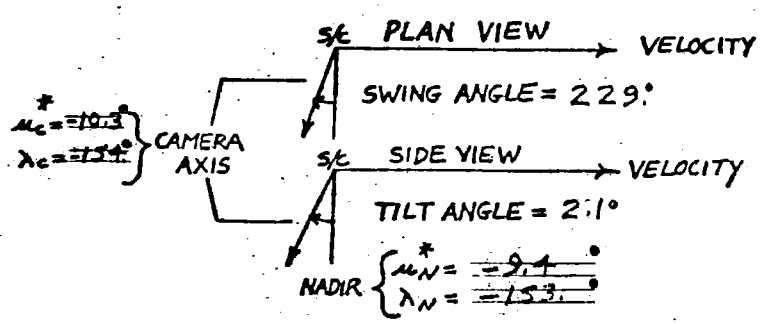
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u=.02204° .295 KM $\nabla\lambda$=.01269° .385 KM	∇u=.02297° .699 KM $\nabla\lambda$=.01338° .406 KM	∇u=.02235° .175 KM $\nabla\lambda$=.01269° .385 KM	∇u=.02366° .720 KM $\nabla\lambda$=.01252° .380 KM	∇u=.02409° .731 KM $\nabla\lambda$=.01256° .382 KM	∇u=.02462° .749 KM $\nabla\lambda$=.01272° .385 KM	∇u=.02354° .712 KM $\nabla\lambda$=.01276° .388 KM	∇u=.02432° .738 KM $\nabla\lambda$=.01334° .405 KM	∇u=.02369° .719 KM $\nabla\lambda$=.01332° .404 KM
NAVIGATION	∇u=.00509 $\nabla\lambda$=.00123	∇u=.00512 $\nabla\lambda$=.00122	∇u=.00509 $\nabla\lambda$=.00123	∇u=.00510 $\nabla\lambda$=.00123	∇u=.00510 $\nabla\lambda$=.00123	∇u=.00510 $\nabla\lambda$=.00123	∇u=.00509 $\nabla\lambda$=.00123	∇u=.00513 $\nabla\lambda$=.00124	∇u=.00512 $\nabla\lambda$=.00123
ATTITUDE	∇u=.02237 $\nabla\lambda$=.01257	∇u=.02222 $\nabla\lambda$=.01327	∇u=.02176 $\nabla\lambda$=.01259	∇u=.02298 $\nabla\lambda$=.01243	∇u=.02343 $\nabla\lambda$=.01244	∇u=.02399 $\nabla\lambda$=.01253	∇u=.02299 $\nabla\lambda$=.01262	∇u=.02357 $\nabla\lambda$=.01324	∇u=.02295 $\nabla\lambda$=.01323
CAMERA ON-TIME	∇u=.00019 $\nabla\lambda$=.00088	∇u=.00019 $\nabla\lambda$=.00088	∇u=.00019 $\nabla\lambda$=.00088	∇u=.00019 $\nabla\lambda$=.00088	∇u=.00019 $\nabla\lambda$=.00088	∇u=.00018 $\nabla\lambda$=.00088	∇u=.00019 $\nabla\lambda$=.00088	∇u=.00020 $\nabla\lambda$=.00088	∇u=.00020 $\nabla\lambda$=.00088
MOON RADIUS	∇u=.00031 $\nabla\lambda$=.00036	∇u=.00276 $\nabla\lambda$=.00087	∇u=.00039 $\nabla\lambda$=.00034	∇u=.00242 $\nabla\lambda$=.00028	∇u=.00229 $\nabla\lambda$=.00087	∇u=.00214 $\nabla\lambda$=.00158	∇u=.00022 $\nabla\lambda$=.00106	∇u=.00306 $\nabla\lambda$=.00099	∇u=.00292 $\nabla\lambda$=.00015

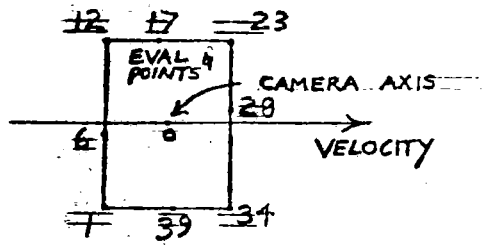
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u=.02701° .820 KM $\nabla\lambda$=.01317° .400 KM	∇u=.02526° .768 KM $\nabla\lambda$=.02092° .618 KM	∇u=.02203° .670 KM $\nabla\lambda$=.01540° .466 KM	∇u=.03037° .920 KM $\nabla\lambda$=.01676° .510 KM	∇u=.03294° .999 KM $\nabla\lambda$=.01352° .410 KM	∇u=.03742° 1.13 KM $\nabla\lambda$=.01727° .522 KM	∇u=.03271° .992 KM $\nabla\lambda$=.01634° .495 KM	∇u=.04009° 1.22 KM $\nabla\lambda$=.01677° .520 KM	∇u=.03262° .990 KM $\nabla\lambda$=.01617° .490 KM
NAVIGATION	∇u=.00509 $\nabla\lambda$=.00123	∇u=.00516 $\nabla\lambda$=.00114	∇u=.00509 $\nabla\lambda$=.00123	∇u=.00523 $\nabla\lambda$=.00130	∇u=.00518 $\nabla\lambda$=.00121	∇u=.00513 $\nabla\lambda$=.00119	∇u=.00510 $\nabla\lambda$=.00129	∇u=.00530 $\nabla\lambda$=.00136	∇u=.00523 $\nabla\lambda$=.00122
ATTITUDE	∇u=.02652 $\nabla\lambda$=.01307	∇u=.02417 $\nabla\lambda$=.01944	∇u=.02143 $\nabla\lambda$=.01459	∇u=.02915 $\nabla\lambda$=.01634	∇u=.03203 $\nabla\lambda$=.01338	∇u=.03678 $\nabla\lambda$=.01577	∇u=.03230 $\nabla\lambda$=.01528	∇u=.03899 $\nabla\lambda$=.01614	∇u=.03155 $\nabla\lambda$=.01609
CAMERA ON-TIME	∇u=.00019 $\nabla\lambda$=.00088	∇u=.00019 $\nabla\lambda$=.00089	∇u=.00019 $\nabla\lambda$=.00088	∇u=.00019 $\nabla\lambda$=.00088	∇u=.00018 $\nabla\lambda$=.00088	∇u=.00017 $\nabla\lambda$=.00091	∇u=.00019 $\nabla\lambda$=.00091	∇u=.00023 $\nabla\lambda$=.00090	∇u=.00021 $\nabla\lambda$=.00088
MOON RADIUS	∇u=.00031 $\nabla\lambda$=.00036	∇u=.00522 $\nabla\lambda$=.00608	∇u=.00028 $\nabla\lambda$=.00471	∇u=.00673 $\nabla\lambda$=.00335	∇u=.00570 $\nabla\lambda$=.00123	∇u=.00464 $\nabla\lambda$=.00687	∇u=.00091 $\nabla\lambda$=.00556	∇u=.00767 $\nabla\lambda$=.00927	∇u=.00644 $\nabla\lambda$=.00052

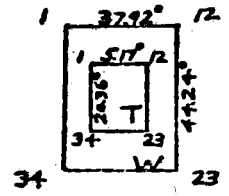
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION I FRAME 28





S/C ALTITUDE = 1302 KM
TRUE ANOMALY = 125 °
INCLINATION ≈ 11.5 °
NOTE: R(-180°) P(0°) Y(0°)



TELEPHOTO LENS, T

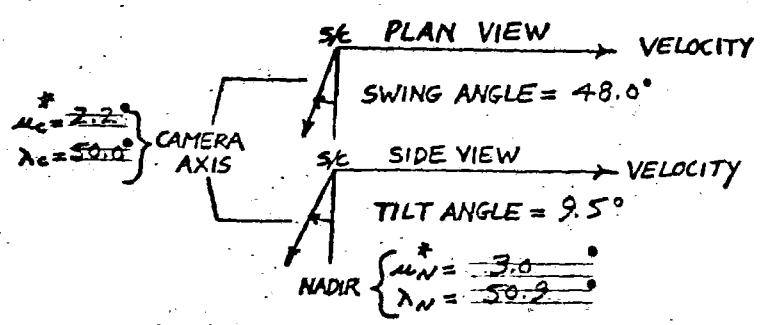
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.20371° 6.16 KM σ_λ=.08718° 2.64 KM	σ_u=.21977° 6.66 KM σ_λ=.11001° 3.33 KM	σ_u=.20014° 6.06 KM σ_λ=.08932° 2.71 KM	σ_u=.21372° 6.47 KM σ_λ=.08805° 2.67 KM	σ_u=.21678° 6.57 KM σ_λ=.08702° 2.64 KM	σ_u=.22118° 6.70 KM σ_λ=.08651° 2.63 KM	σ_u=.20802° 6.30 KM σ_λ=.08607° 2.61 KM	σ_u=.22922° 6.94 KM σ_λ=.10411° 3.15 KM	σ_u=.22460° 6.81 KM σ_λ=.10624° 3.22 KM
NAVIGATION	σ_u=.00309 σ_λ=.00270	σ_u=.00317 σ_λ=.00287	σ_u=.00309 σ_λ=.00274	σ_u=.00323 σ_λ=.00266	σ_u=.00323 σ_λ=.00265	σ_u=.00324 σ_λ=.00265	σ_u=.00316 σ_λ=.00269	σ_u=.00317 σ_λ=.00279	σ_u=.00317 σ_λ=.00252
ATTITUDE	σ_u=.20369 σ_λ=.08704	σ_u=.21970 σ_λ=.10974	σ_u=.20012 σ_λ=.08925	σ_u=.21366 σ_λ=.08799	σ_u=.21673 σ_λ=.08698	σ_u=.22113 σ_λ=.08676	σ_u=.20800 σ_λ=.08602	σ_u=.22914 σ_λ=.10406	σ_u=.22452 σ_λ=.10619
CAMERA ON-TIME	σ_u=.00014 σ_λ=.00112	σ_u=.00010 σ_λ=.00115	σ_u=.00014 σ_λ=.00112	σ_u=.00020 σ_λ=.00110	σ_u=.00021 σ_λ=.00111	σ_u=.00022 σ_λ=.00113	σ_u=.00015 σ_λ=.00114	σ_u=.00009 σ_λ=.00117	σ_u=.00009 σ_λ=.00116
MOON RADIUS	σ_u=.00049 σ_λ=.00070	σ_u=.00473 σ_λ=.00240	σ_u=.00076 σ_λ=.00181	σ_u=.00382 σ_λ=.00138	σ_u=.00371 σ_λ=.00043	σ_u=.00360 σ_λ=.00071	σ_u=.00021 σ_λ=.00038	σ_u=.00492 σ_λ=.00002	σ_u=.00483 σ_λ=.00110

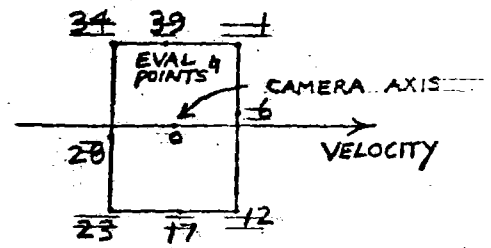
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.22576° 6.85 KM σ_λ=.09024° 2.73 KM	σ_u=.37862° 11.5 KM σ_λ=.47433° 14.3 KM	σ_u=.19976° 6.05 KM σ_λ=.13571° 4.11 KM	σ_u=.36486° 11.1 KM σ_λ=.23820° 7.21 KM	σ_u=.32121° 9.97 KM σ_λ=.12238° 3.70 KM	σ_u=.41262° 12.5 KM σ_λ=.15548° 4.70 KM	σ_u=.28897° 8.75 KM σ_λ=.11127° 3.37 KM	σ_u=.49832° 15.1 KM σ_λ=.20534° 6.25 KM	σ_u=.37610° 11.4 KM σ_λ=.18323° 5.55 KM
NAVIGATION	σ_u=.00307 σ_λ=.00270	σ_u=.00408 σ_λ=.00554	σ_u=.00305 σ_λ=.00332	σ_u=.00419 σ_λ=.00322	σ_u=.00385 σ_λ=.00267	σ_u=.00408 σ_λ=.00342	σ_u=.00314 σ_λ=.00272	σ_u=.00392 σ_λ=.00330	σ_u=.00378 σ_λ=.00312
ATTITUDE	σ_u=.22573 σ_λ=.09019	σ_u=.37835 σ_λ=.47377	σ_u=.19974 σ_λ=.13525	σ_u=.36454 σ_λ=.23786	σ_u=.32902 σ_λ=.12232	σ_u=.41245 σ_λ=.15503	σ_u=.28895 σ_λ=.11092	σ_u=.49802 σ_λ=.20536	σ_u=.37587 σ_λ=.18299
CAMERA ON-TIME	σ_u=.00014 σ_λ=.00112	σ_u=.00021 σ_λ=.00166	σ_u=.00010 σ_λ=.00121	σ_u=.00012 σ_λ=.00117	σ_u=.00032 σ_λ=.00111	σ_u=.00057 σ_λ=.00153	σ_u=.00020 σ_λ=.00137	σ_u=.00015 σ_λ=.00166	σ_u=.00003 σ_λ=.00128
MOON RADIUS	σ_u=.00049 σ_λ=.00070	σ_u=.01383 σ_λ=.02227	σ_u=.00017 σ_λ=.01056	σ_u=.01462 σ_λ=.01230	σ_u=.01051 σ_λ=.00067	σ_u=.01111 σ_λ=.01095	σ_u=.00009 σ_λ=.00814	σ_u=.01515 σ_λ=.01350	σ_u=.01267 σ_λ=.00138

* σ_u = LATITUDE σ_λ = LONGITUDE

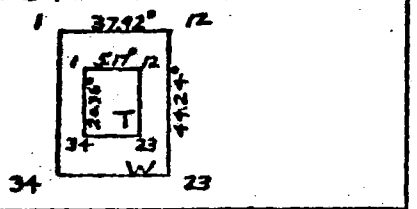
ERROR ANALYSIS RESULTS MISSION I FRAME 32





S/C ALTITUDE = 233.7 KM
TRUE ANOMALY = 34.1°
INCLINATION ≈ 11.5°
NOTE:

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

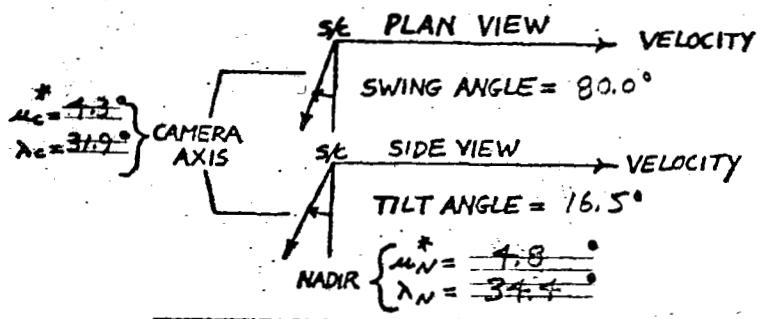
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .02812° .851 KM, σ_λ = .01696° .514 KM	σ_μ = .02610° .790 KM, σ_λ = .01780° .540 KM	σ_μ = .02637° .799 KM, σ_λ = .01683° .510 KM	σ_μ = .02916° .882 KM, σ_λ = .01803° .546 KM	σ_μ = .03079° .930 KM, σ_λ = .01804° .546 KM	σ_μ = .03260° .987 KM, σ_λ = .01817° .550 KM	σ_μ = .02992° .905 KM, σ_λ = .01720° .521 KM	σ_μ = .02924° .885 KM, σ_λ = .01811° .550 KM	σ_μ = .02780° .843 KM, σ_λ = .01792° .544 KM
NAVIGATION	σ_μ = .00326, σ_λ = .00890	σ_μ = .00341, σ_λ = .00887	σ_μ = .00327, σ_λ = .00891	σ_μ = .00316, σ_λ = .00876	σ_μ = .00316, σ_λ = .00885	σ_μ = .00316, σ_λ = .00871	σ_μ = .00325, σ_λ = .00868	σ_μ = .00342, σ_λ = .00862	σ_μ = .00341, σ_λ = .00873
ATTITUDE	σ_μ = .02788, σ_λ = .01428	σ_μ = .02585, σ_λ = .01529	σ_μ = .02615, σ_λ = .01412	σ_μ = .02864, σ_λ = .01550	σ_μ = .03021, σ_λ = .01551	σ_μ = .03213, σ_λ = .01561	σ_μ = .02963, σ_λ = .01452	σ_μ = .02901, σ_λ = .01563	σ_μ = .02756, σ_λ = .01544
CAMERA ON-TIME	σ_μ = .00034, σ_λ = .00172	σ_μ = .00037, σ_λ = .00171	σ_μ = .00034, σ_λ = .00171	σ_μ = .00032, σ_λ = .00171	σ_μ = .00031, σ_λ = .00172	σ_μ = .00031, σ_λ = .00173	σ_μ = .00034, σ_λ = .00173	σ_μ = .00037, σ_λ = .00173	σ_μ = .00037, σ_λ = .00172
MOON RADIUS	σ_μ = .00163, σ_λ = .00189	σ_μ = .00103, σ_λ = .00114	σ_μ = .00139, σ_λ = .00120	σ_μ = .00446, σ_λ = .00128	σ_μ = .00447, σ_λ = .00192	σ_μ = .00449, σ_λ = .00271	σ_μ = .00187, σ_λ = .00260	σ_μ = .00108, σ_λ = .00250	σ_μ = .00105, σ_λ = .00188

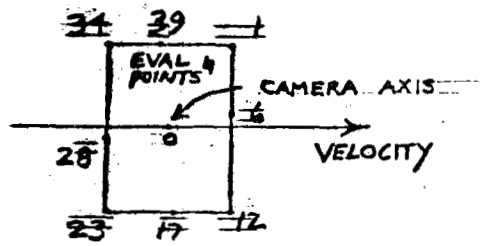
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .03333° 1.01 KM, σ_λ = .01742° .528 KM	σ_μ = .02245° .681 KM, σ_λ = .02573° .779 KM	σ_μ = .01938° .587 KM, σ_λ = .01852° .561 KM	σ_μ = .02935° .890 KM, σ_λ = .02870° .870 KM	σ_μ = .04353° 1.32 KM, σ_λ = .02431° .736 KM	σ_μ = .06502° 1.97 KM, σ_λ = .02494° .754 KM	σ_μ = .05001° 1.51 KM, σ_λ = .02211° .670 KM	σ_μ = .05057° 1.53 KM, σ_λ = .02554° .772 KM	σ_μ = .03657° 1.11 KM, σ_λ = .02334° .706 KM
NAVIGATION	σ_μ = .00326, σ_λ = .00880	σ_μ = .00367, σ_λ = .00960	σ_μ = .00327, σ_λ = .00972	σ_μ = .00314, σ_λ = .00993	σ_μ = .00315, σ_λ = .00977	σ_μ = .00323, σ_λ = .00759	σ_μ = .00322, σ_λ = .00764	σ_μ = .00380, σ_λ = .00745	σ_μ = .00370, σ_λ = .00858
ATTITUDE	σ_μ = .03313, σ_λ = .01482	σ_μ = .02177, σ_λ = .02361	σ_μ = .01906, σ_λ = .01535	σ_μ = .02799, σ_λ = .02668	σ_μ = .04264, σ_λ = .02376	σ_μ = .06430, σ_λ = .02210	σ_μ = .04985, σ_λ = .01919	σ_μ = .05020, σ_λ = .02324	σ_μ = .03612, σ_λ = .02152
CAMERA ON-TIME	σ_μ = .00034, σ_λ = .00172	σ_μ = .00039, σ_λ = .00168	σ_μ = .00035, σ_λ = .00168	σ_μ = .00033, σ_λ = .00169	σ_μ = .00028, σ_λ = .00171	σ_μ = .00021, σ_λ = .00184	σ_μ = .00032, σ_λ = .00183	σ_μ = .00044, σ_λ = .00184	σ_μ = .00041, σ_λ = .00173
MOON RADIUS	σ_μ = .00163, σ_λ = .00189	σ_μ = .00404, σ_λ = .00315	σ_μ = .00120, σ_λ = .00315	σ_μ = .00827, σ_λ = .00334	σ_μ = .00844, σ_λ = .00165	σ_μ = .00910, σ_λ = .00852	σ_μ = .00221, σ_λ = .00766	σ_μ = .00478, σ_λ = .00730	σ_μ = .00497, σ_λ = .00220

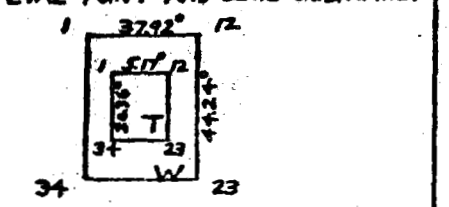
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION I FRAME 42





s/c ALTITUDE = 261.2 KM
TRUE ANOMALY = 332. °
INCLINATION ≈ 11.5 °
NOTE:



TELEPHOTO LENS, T

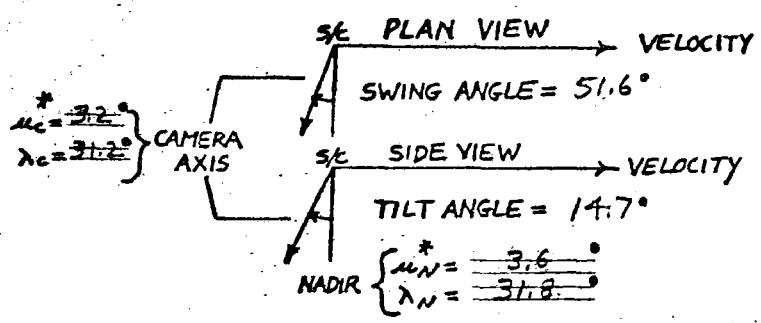
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.03312° 1.00 KM; σ_λ=.02031° .615 KM	σ_u=.03147° .954 KM; σ_λ=.02082° .630 KM	σ_u=.03101° .940 KM; σ_λ=.01968° .595 KM	σ_u=.03279° .994 KM; σ_λ=.02112° .640 KM	σ_u=.03475° 1.05 KM; σ_λ=.02161° .655 KM	σ_u=.03720° .113 KM; σ_λ=.02235° .677 KM	σ_u=.03534° 1.07 KM; σ_λ=.02109° .640 KM	σ_u=.03564° 1.08 KM; σ_λ=.02212° .669 KM	σ_u=.03370° 1.02 KM; σ_λ=.02148° .650 KM
NAVIGATION	σ_u=.00292 σ_λ=.00965	σ_u=.00312 σ_λ=.00960	σ_u=.00295 σ_λ=.00956	σ_u=.00279 σ_λ=.00952	σ_u=.00277 σ_λ=.00963	σ_u=.00275 σ_λ=.00971	σ_u=.00290 σ_λ=.00974	σ_u=.00313 σ_λ=.00980	σ_u=.00312 σ_λ=.00971
ATTITUDE	σ_u=.03298 σ_λ=.01722	σ_u=.03125 σ_λ=.01801	σ_u=.03086 σ_λ=.01671	σ_u=.03246 σ_λ=.01840	σ_u=.03443 σ_λ=.01877	σ_u=.03690 σ_λ=.01935	σ_u=.03521 σ_λ=.01787	σ_u=.03544 σ_λ=.01903	σ_u=.03349 σ_λ=.01851
CAMERA ON-TIME	σ_u=.00032 σ_λ=.00176	σ_u=.00037 σ_λ=.00175	σ_u=.00032 σ_λ=.00175	σ_u=.00027 σ_λ=.00174	σ_u=.00027 σ_λ=.00176	σ_u=.00026 σ_λ=.00178	σ_u=.00031 σ_λ=.00178	σ_u=.00037 σ_λ=.00179	σ_u=.00037 σ_λ=.00177
MOON RADIUS	σ_u=.00083 σ_λ=.00446	σ_u=.00198 σ_λ=.00373	σ_u=.00056 σ_λ=.00370	σ_u=.00369 σ_λ=.00372	σ_u=.00375 σ_λ=.00441	σ_u=.00384 σ_λ=.00527	σ_u=.00112 σ_λ=.00525	σ_u=.00204 σ_λ=.00528	σ_u=.00202 σ_λ=.00456

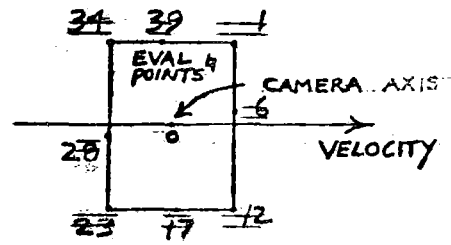
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.03878° 1.18 KM; σ_λ=.02086° .633 KM	σ_u=.02659° .804 KM; σ_λ=.02720° .825 KM	σ_u=.02239° .680 KM; σ_λ=.01875° .569 KM	σ_u=.02870° .876 KM; σ_λ=.02875° .870 KM	σ_u=.04553° 1.39 KM; σ_λ=.02824° .867 KM	σ_u=.07624° 2.31 KM; σ_λ=.03677° 1.11 KM	σ_u=.06234° 1.89 KM; σ_λ=.03173° .961 KM	σ_u=.06740° 2.04 KM; σ_λ=.03610° 1.09 KM	σ_u=.04518° 1.37 KM; σ_λ=.02819° .854 KM
NAVIGATION	σ_u=.00292 σ_λ=.00965	σ_u=.00325 σ_λ=.00924	σ_u=.00230 σ_λ=.00919	σ_u=.00284 σ_λ=.00916	σ_u=.00266 σ_λ=.00953	σ_u=.00234 σ_λ=.01081	σ_u=.00278 σ_λ=.01083	σ_u=.00373 σ_λ=.01113	σ_u=.00348 σ_λ=.00986
ATTITUDE	σ_u=.03886 σ_λ=.01786	σ_u=.02584 σ_λ=.02552	σ_u=.02218 σ_λ=.01625	σ_u=.02792 σ_λ=.02719	σ_u=.04511 σ_λ=.02665	σ_u=.07561 σ_λ=.03280	σ_u=.06225 σ_λ=.02739	σ_u=.06696 σ_λ=.03212	σ_u=.04469 σ_λ=.02584
CAMERA ON-TIME	σ_u=.00032 σ_λ=.00176	σ_u=.00040 σ_λ=.00169	σ_u=.00034 σ_λ=.00167	σ_u=.00027 σ_λ=.00167	σ_u=.00021 σ_λ=.00174	σ_u=.00010 σ_λ=.00198	σ_u=.00028 σ_λ=.00198	σ_u=.00050 σ_λ=.00203	σ_u=.00044 σ_λ=.00180
MOON RADIUS	σ_u=.00083 σ_λ=.00446	σ_u=.00507 σ_λ=.00066	σ_u=.00023 σ_λ=.00073	σ_u=.00089 σ_λ=.00085	σ_u=.00766 σ_λ=.10407	σ_u=.00954 σ_λ=.01246	σ_u=.00174 σ_λ=.01165	σ_u=.00665 σ_λ=.01198	σ_u=.00571 σ_λ=.00515

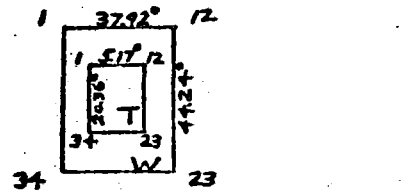
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION I FRAME 46





S/C ALTITUDE = 82.4 KM
TRUE ANOMALY = 341.
INCLINATION ≈ 11.5°
NOTE:



TELEPHOTO LENS, T

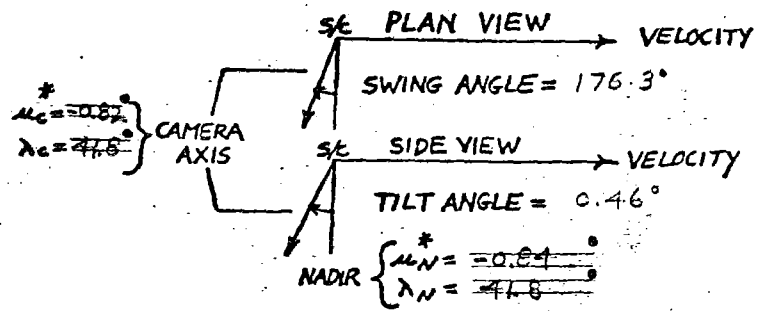
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.0104° .315 KM, σ_λ=.00726° .220 KM	σ_u=.00928° .281 KM, σ_λ=.00723° .219 KM	σ_u=.00974° .295 KM, σ_λ=.00694° .210 KM	σ_u=.01156° .350 KM, σ_λ=.00735° .223 KM	σ_u=.[illegible]° [illegible] KM, σ_λ=.00760° .230 KM	σ_u=.01281° .387 KM, σ_λ=.00799° .242 KM	σ_u=.01116° .338 KM, σ_λ=.00765° .232 KM	σ_u=.01045° .316 KM, σ_λ=.00788° .239 KM	σ_u=.00991° .300 KM, σ_λ=.00755° .229 KM
NAVIGATION	σ_u=.00158, σ_λ=.00372	σ_u=.00161, σ_λ=.00371	σ_u=.00158, σ_λ=.00371	σ_u=.00156, σ_λ=.00371	σ_u=.00155, σ_λ=.00372	σ_u=.00155, σ_λ=.00373	σ_u=.00158, σ_λ=.00373	σ_u=.00161, σ_λ=.00374	σ_u=.00161, σ_λ=.00373
ATTITUDE	σ_u=.01007, σ_λ=.00521	σ_u=.00913, σ_λ=.00552	σ_u=.00946, σ_λ=.00511	σ_u=.01037, σ_λ=.00561	σ_u=.01098, σ_λ=.00565	σ_u=.01173, σ_λ=.00572	σ_u=.01077, σ_λ=.00533	σ_u=.01031, σ_λ=.00574	σ_u=.00976, σ_λ=.00563
CAMERA ON-TIME	σ_u=.00034, σ_λ=.00183	σ_u=.00037, σ_λ=.00182	σ_u=.00034, σ_λ=.00182	σ_u=.00031, σ_λ=.00182	σ_u=.00031, σ_λ=.00183	σ_u=.00031, σ_λ=.00184	σ_u=.00034, σ_λ=.00184	σ_u=.00037, σ_λ=.00184	σ_u=.00037, σ_λ=.00183
MOON RADIUS	σ_u=.00217, σ_λ=.00289	σ_u=.00032, σ_λ=.00215	σ_u=.00195, σ_λ=.00223	σ_u=.00484, σ_λ=.00234	σ_u=.[illegible], σ_λ=.00295	σ_u=.00489, σ_λ=.00370	σ_u=.00241, σ_λ=.00357	σ_u=.00037, σ_λ=.00343	σ_u=.00035, σ_λ=.00284

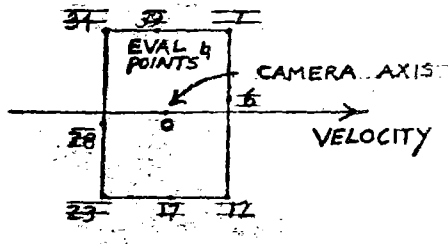
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.0123° .373 KM, σ_λ=.00740° .224 KM	σ_u=.00790° .239 KM, σ_λ=.00900° .272 KM	σ_u=.00709° .214 KM, σ_λ=.00688° .208 KM	σ_u=.01260° .382 KM, σ_λ=.01016° .308 KM	σ_u=.01756° .531 KM, σ_λ=.00952° .288 KM	σ_u=.02560° .775 KM, σ_λ=.01333° .401 KM	σ_u=.01879° .568 KM, σ_λ=.01200° .364 KM	σ_u=.01789° .541 KM, σ_λ=.01268° .384 KM	σ_u=.01285° .389 KM, σ_λ=.00939° .264 KM
NAVIGATION	σ_u=.00158, σ_λ=.00372	σ_u=.00164, σ_λ=.00366	σ_u=.00160, σ_λ=.00366	σ_u=.00157, σ_λ=.00366	σ_u=.00153, σ_λ=.00371	σ_u=.00147, σ_λ=.00385	σ_u=.00156, σ_λ=.00385	σ_u=.00168, σ_λ=.00386	σ_u=.00166, σ_λ=.00374
ATTITUDE	σ_u=.0120, σ_λ=.00541	σ_u=.00711, σ_λ=.00784	σ_u=.00667, σ_λ=.00525	σ_u=.00947, σ_λ=.00912	σ_u=.01526, σ_λ=.00814	σ_u=.02385, σ_λ=.00838	σ_u=.01846, σ_λ=.00734	σ_u=.01740, σ_λ=.00901	σ_u=.01228, σ_λ=.00782
CAMERA ON-TIME	σ_u=.00034, σ_λ=.00183	σ_u=.00040, σ_λ=.00178	σ_u=.00035, σ_λ=.00178	σ_u=.00027, σ_λ=.00178	σ_u=.00027, σ_λ=.00183	σ_u=.00023, σ_λ=.00193	σ_u=.00032, σ_λ=.00192	σ_u=.00042, σ_λ=.00192	σ_u=.00041, σ_λ=.00184
MOON RADIUS	σ_u=.00217, σ_λ=.00289	σ_u=.00295, σ_λ=.00173	σ_u=.00174, σ_λ=.00176	σ_u=.00816, σ_λ=.00187	σ_u=.00855, σ_λ=.00272	σ_u=.00926, σ_λ=.00929	σ_u=.00273, σ_λ=.00846	σ_u=.00381, σ_λ=.00781	σ_u=.00337, σ_λ=.00309

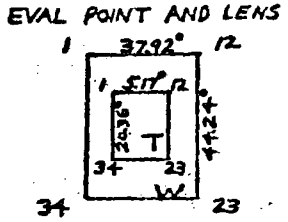
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION I FRAME 59





S/C ALTITUDE = [illegible] KM
TRUE ANOMALY = [illegible]°
INCLINATION ≈ [illegible]°
NOTE: [illegible]



TELEPHOTO LENS, T

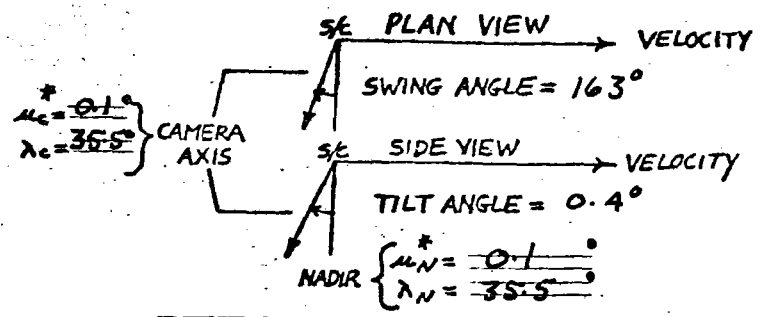
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00556° .168 KM σ_λ=.00340° .103 KM	σ_u=.00602° .183 KM σ_λ=.00670° .203 KM	σ_u=.00556° .168 KM σ_λ=.00348° .106 KM	σ_u=.00620° .188 KM σ_λ=.00338° .102 KM	σ_u=.00623° .189 KM σ_λ=.00341° .104 KM	σ_u=.00628° .190 KM σ_λ=.00356° .108 KM	σ_u=.00567° .172 KM σ_λ=.00346° .105 KM	σ_u=.00636° .193 KM σ_λ=.00350° .106 KM	σ_u=.00620° .188 KM σ_λ=.00353° .107 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.00555 σ_λ=.00327	σ_u=.00553 σ_λ=.00339	σ_u=.00544 σ_λ=.00328	σ_u=.00572 σ_λ=.00325	σ_u=.00580 σ_λ=.00325	σ_u=.00590 σ_λ=.00326	σ_u=.00567 σ_λ=.00327	σ_u=.00579 σ_λ=.00337	σ_u=.00567 σ_λ=.00338
CAMERA ON-TIME	σ_u=.00020 σ_λ=.00093	σ_u=.00019 σ_λ=.00094	σ_u=.00020 σ_λ=.00093	σ_u=.00020 σ_λ=.00093	σ_u=.00020 σ_λ=.00093	σ_u=.00020 σ_λ=.00093	σ_u=.00020 σ_λ=.00093	σ_u=.00020 σ_λ=.00093	σ_u=.00019 σ_λ=.00093
MOON RADIUS	σ_u=.00011 σ_λ=.00002	σ_u=.00236 σ_λ=.00112	σ_u=.00019 σ_λ=.00066	σ_u=.00240 σ_λ=.00011	σ_u=.00094 σ_λ=.00044	σ_u=.00214 σ_λ=.00109	σ_u=.00002 σ_λ=.00063	σ_u=.00262 σ_λ=.00067	σ_u=.00250 σ_λ=.00047

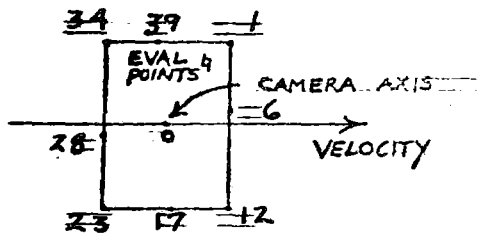
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00659° .200 KM σ_λ=.00352° .107 KM	σ_u=.00769° .233 KM σ_λ=.00748° .226 KM	σ_u=.00562° .170 KM σ_λ=.00611° .186 KM	σ_u=.00965° .293 KM σ_λ=.00541° .164 KM	σ_u=.00949° .287 KM σ_λ=.00363° .110 KM	σ_u=.00960° .290 KM σ_λ=.00698° .211 KM	σ_u=.00765° .232 KM σ_λ=.00608° .184 KM	σ_u=.01109° .335 KM σ_λ=.00526° .159 KM	σ_u=.00947° .286 KM σ_λ=.00406° .123 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.00658 σ_λ=.00339	σ_u=.00618 σ_λ=.00466	σ_u=.00560 σ_λ=.00382	σ_u=.00734 σ_λ=.00408	σ_u=.00782 σ_λ=.00343	σ_u=.00857 σ_λ=.00391	σ_u=.00763 σ_λ=.00382	σ_u=.00896 σ_λ=.00389	σ_u=.00762 σ_λ=.00387
CAMERA ON-TIME	σ_u=.00020 σ_λ=.00093	σ_u=.00019 σ_λ=.00094	σ_u=.00020 σ_λ=.00094	σ_u=.00021 σ_λ=.00094	σ_u=.00020 σ_λ=.00093	σ_u=.00020 σ_λ=.00093	σ_u=.00020 σ_λ=.00093	σ_u=.00020 σ_λ=.00093	σ_u=.00019 σ_λ=.00093
MOON RADIUS	σ_u=.00011 σ_λ=.00002	σ_u=.00957 σ_λ=.00578	σ_u=.00040 σ_λ=.00468	σ_u=.00627 σ_λ=.00393	σ_u=.00536 σ_λ=.00074	σ_u=.00432 σ_λ=.00571	σ_u=.00062 σ_λ=.00465	σ_u=.00654 σ_λ=.00392	σ_u=.00562 σ_λ=.00077

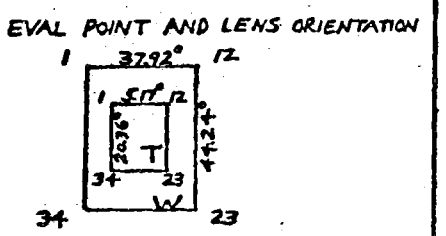
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION I FRAME 75





S/C ALTITUDE = 54.3 KM
TRUE ANOMALY = 358 °
INCLINATION ≈ 11.5 °
NOTE:



TELEPHOTO LENS, T

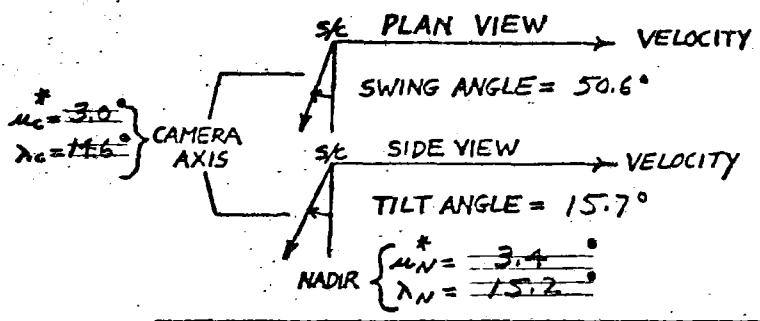
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.00614° .186 KM σ_λ=.00375° .114 KM	σ_μ=.00639° .194 KM σ_λ=.00415° .126 KM	σ_μ=.00591° .180 KM σ_λ=.00381° .116 KM	σ_μ=.00676° .205 KM σ_λ=.00373° .113 KM	σ_μ=.00688° .208 KM σ_λ=.00375° .114 KM	σ_μ=.00703° .214 KM σ_λ=.00389° .118 KM	σ_μ=.00637° .193 KM σ_λ=.00381° .116 KM	σ_μ=.00692° .210 KM σ_λ=.00399° .121 KM	σ_μ=.00668° .202 KM σ_λ=.00402° .122 KM
NAVIGATION	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0
ATTITUDE	σ_μ=.00613 σ_λ=.00328	σ_μ=.00593 σ_λ=.00357	σ_μ=.00590 σ_λ=.00329	σ_μ=.00630 σ_λ=.00326	σ_μ=.00647 σ_λ=.00324	σ_μ=.00688 σ_λ=.00325	σ_μ=.00636 σ_λ=.00328	σ_μ=.00690 σ_λ=.00355	σ_μ=.00618 σ_λ=.00353
CAMERA ON-TIME	σ_μ=.00038 σ_λ=.00182	σ_μ=.00039 σ_λ=.00182	σ_μ=.00038 σ_λ=.00182	σ_μ=.00038 σ_λ=.00182	σ_μ=.00038 σ_λ=.00182	σ_μ=.00038 σ_λ=.00182	σ_μ=.00038 σ_λ=.00182	σ_μ=.00039 σ_λ=.00182	σ_μ=.00039 σ_λ=.00182
MOON RADIUS	σ_μ=.00010 σ_λ=.00008	σ_μ=.00236 σ_λ=.00110	σ_μ=.00018 σ_λ=.00064	σ_μ=.00241 σ_λ=.00008	σ_μ=.00229 σ_λ=.00047	σ_μ=.00215 σ_λ=.00112	σ_μ=.00001 σ_λ=.00065	σ_μ=.00261 σ_λ=.00009	σ_μ=.00249 σ_λ=.00095

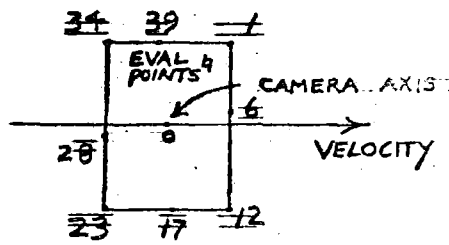
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.00728° .220 KM σ_λ=.00386° .117 KM	σ_μ=.00735° .223 KM σ_λ=.00810° .245 KM	σ_μ=.00536° .162 KM σ_λ=.00628° .190 KM	σ_μ=.00977° .299 KM σ_λ=.00609° .184 KM	σ_μ=.01031° .313 KM σ_λ=.00420° .128 KM	σ_μ=.01142° .345 KM σ_λ=.00717° .214 KM	σ_μ=.00931° .282 KM σ_λ=.00633° .192 KM	σ_μ=.01235° .375 KM σ_λ=.00595° .180 KM	σ_μ=.00998° .303 KM σ_λ=.00505° .153 KM
NAVIGATION	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0	σ_μ=0 σ_λ=0
ATTITUDE	σ_μ=.00727 σ_λ=.00341	σ_μ=.00577 σ_λ=.00540	σ_μ=.00533 σ_λ=.00380	σ_μ=.00746 σ_λ=.00471	σ_μ=.00879 σ_λ=.00370	σ_μ=.01056 σ_λ=.00388	σ_μ=.00828 σ_λ=.00385	σ_μ=.01048 σ_λ=.00451	σ_μ=.00826 σ_λ=.00465
CAMERA ON-TIME	σ_μ=.00038 σ_λ=.00182	σ_μ=.00038 σ_λ=.00182	σ_μ=.00038 σ_λ=.00182	σ_μ=.00038 σ_λ=.00182	σ_μ=.00038 σ_λ=.00182	σ_μ=.00037 σ_λ=.00184	σ_μ=.00039 σ_λ=.00183	σ_μ=.00040 σ_λ=.00183	σ_μ=.00039 σ_λ=.00182
MOON RADIUS	σ_μ=.00010 σ_λ=.00001	σ_μ=.00454 σ_λ=.00576	σ_μ=.00042 σ_λ=.00465	σ_μ=.00629 σ_λ=.00339	σ_μ=.00538 σ_λ=.00077	σ_μ=.00433 σ_λ=.00575	σ_μ=.00061 σ_λ=.00467	σ_μ=.00653 σ_λ=.00394	σ_μ=.00560 σ_λ=.00076

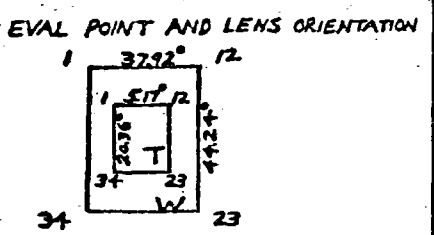
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION I FRAME 84





S/C ALTITUDE = 78.5 KM
TRUE ANOMALY = 341. °
INCLINATION ≈ 11.5 °
NOTE:



TELEPHOTO LENS, T

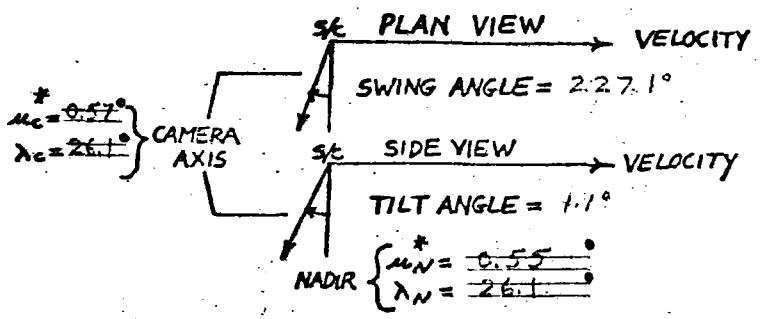
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .01004° .304 KM σ_λ = .00620° .188 KM	σ_μ = .00881° .267 KM σ_λ = .00612° .186 KM	σ_μ = .00936° .283 KM σ_λ = .00582° .176 KM	σ_μ = .01128° .343 KM σ_λ = .00627° .190 KM	σ_μ = .01182° .360 KM σ_λ = .00658° .199 KM	σ_μ = .01249° .380 KM σ_λ = .00704° .214 KM	σ_μ = .01075° .325 KM σ_λ = .00667° .202 KM	σ_μ = .00993° .301 KM σ_λ = .00689° .207 KM	σ_μ = .00941° .285 KM σ_λ = .00650° .197 KM
NAVIGATION	σ_μ = .00124 σ_λ = .00093	σ_μ = .00127 σ_λ = .00091	σ_μ = .00125 σ_λ = .00091	σ_μ = .00122 σ_λ = .00091	σ_μ = .00122 σ_λ = .00092	σ_μ = .00122 σ_λ = .00093	σ_μ = .00124 σ_λ = .00093	σ_μ = .00127 σ_λ = .00093	σ_μ = .00127 σ_λ = .00093
ATTITUDE	σ_μ = .00967 σ_λ = .00500	σ_μ = .00871 σ_λ = .00529	σ_μ = .00902 σ_λ = .00940	σ_μ = .01000 σ_λ = .00538	σ_μ = .01060 σ_λ = .00542	σ_μ = .01133 σ_λ = .00550	σ_μ = .01035 σ_λ = .00512	σ_μ = .00984 σ_λ = .00552	σ_μ = .00932 σ_λ = .00540
CAMERA ON-TIME	σ_μ = .00034 σ_λ = .00184	σ_μ = .00037 σ_λ = .00183	σ_μ = .00035 σ_λ = .00183	σ_μ = .00031 σ_λ = .00183	σ_μ = .00031 σ_λ = .00184	σ_μ = .00031 σ_λ = .00185	σ_μ = .00034 σ_λ = .00185	σ_μ = .00037 σ_λ = .00185	σ_μ = .00037 σ_λ = .00184
MOON RADIUS	σ_μ = .00237 σ_λ = .00304	σ_μ = .00012 σ_λ = .00229	σ_μ = .00214 σ_λ = .00238	σ_μ = .00506 σ_λ = .00250	σ_μ = .00508 σ_λ = .00312	σ_μ = .00511 σ_λ = .00388	σ_μ = .00261 σ_λ = .00373	σ_μ = .00018 σ_λ = .00358	σ_μ = .00015 σ_λ = .00299

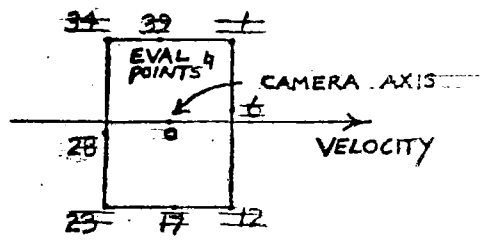
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .01180° .358 KM σ_λ = .00636° .192 KM	σ_μ = .00737° .223 KM σ_λ = .00784° .237 KM	σ_μ = .00697° .211 KM σ_λ = .00561° .170 KM	σ_μ = .01246° .378 KM σ_λ = .00913° .277 KM	σ_μ = .01727° .523 KM σ_λ = .00859° .260 KM	σ_μ = .02526° .765 KM σ_λ = .01275° .388 KM	σ_μ = .01810° .550 KM σ_λ = .01144° .346 KM	σ_μ = .01696° .514 KM σ_λ = .01201° .364 KM	σ_μ = .01213° .367 KM σ_λ = .00842° .250 KM
NAVIGATION	σ_μ = .00124 σ_λ = .00092	σ_μ = .00130 σ_λ = .00086	σ_μ = .00125 σ_λ = .00086	σ_μ = .00121 σ_λ = .00086	σ_μ = .00120 σ_λ = .00092	σ_μ = .00119 σ_λ = .00102	σ_μ = .00123 σ_λ = .00101	σ_μ = .00131 σ_λ = .00101	σ_μ = .00130 σ_λ = .00093
ATTITUDE	σ_μ = .01149 σ_λ = .00519	σ_μ = .00671 σ_λ = .00742	σ_μ = .00638 σ_λ = .00500	σ_μ = .00912 σ_λ = .00874	σ_μ = .01480 σ_λ = .00782	σ_μ = .01233 σ_λ = .00812	σ_μ = .01781 σ_λ = .00714	σ_μ = .01652 σ_λ = .00875	σ_μ = .01163 σ_λ = .00750
CAMERA ON-TIME	σ_μ = .00034 σ_λ = .00184	σ_μ = .00040 σ_λ = .00178	σ_μ = .00035 σ_λ = .00178	σ_μ = .00029 σ_λ = .00178	σ_μ = .00027 σ_λ = .00183	σ_μ = .00023 σ_λ = .00191	σ_μ = .00033 σ_λ = .00193	σ_μ = .00043 σ_λ = .00192	σ_μ = .00041 σ_λ = .00184
MOON RADIUS	σ_μ = .00237 σ_λ = .00304	σ_μ = .00273 σ_λ = .00157	σ_μ = .00193 σ_λ = .00163	σ_μ = .00840 σ_λ = .00173	σ_μ = .00833 σ_λ = .00290	σ_μ = .00959 σ_λ = .00958	σ_μ = .00294 σ_λ = .00267	σ_μ = .00361 σ_λ = .00794	σ_μ = .00316 σ_λ = .00322

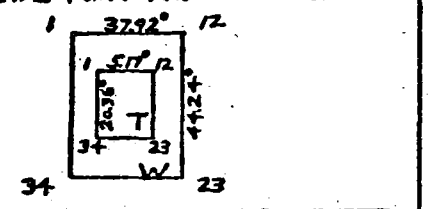
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION I FRAME 92





S/C ALTITUDE = 53.6 KM
TRUE ANOMALY = 355.7°
INCLINATION = 11.5°
NOTE: Apollo TC-1, IA-3
t16



TELEPHOTO LENS, T

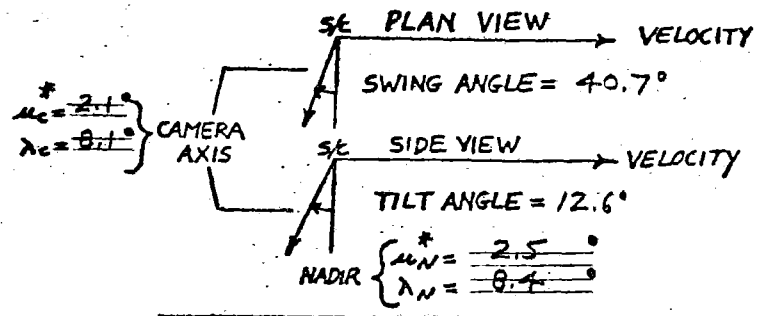
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00699° .212 KM σ_λ=.00502° .154 KM	σ_u=.00715° .217 KM σ_λ=.00545° .166 KM	σ_u=.00673° .205 KM σ_λ=.00509° .154 KM	σ_u=.00749° .226 KM σ_λ=.00503° .152 KM	σ_u=.00765° .232 KM σ_λ=.00503° .153 KM	σ_u=.00786° .239 KM σ_λ=.00511° .156 KM	σ_u=.00726° .220 KM σ_λ=.00505° .153 KM	σ_u=.00774° .235 KM σ_λ=.00531° .162 KM	σ_u=.00747° .226 KM σ_λ=.00534° .162 KM
NAVIGATION	σ_u=.00325 σ_λ=.00376	σ_u=.00331 σ_λ=.00373	σ_u=.00326 σ_λ=.00374	σ_u=.00320 σ_λ=.00376	σ_u=.00322 σ_λ=.00378	σ_u=.00320 σ_λ=.00378	σ_u=.00322 σ_λ=.00379	σ_u=.00332 σ_λ=.00377	σ_u=.00331 σ_λ=.00375
ATTITUDE	σ_u=.00618 σ_λ=.00318	σ_u=.00587 σ_λ=.00363	σ_u=.00588 σ_λ=.00320	σ_u=.00634 σ_λ=.00320	σ_u=.00655 σ_λ=.00317	σ_u=.00646 σ_λ=.00316	σ_u=.00694 σ_λ=.00317	σ_u=.00648 σ_λ=.00362	σ_u=.00620 σ_λ=.00362
CAMERA ON-TIME	σ_u=.00019 σ_λ=.00094	σ_u=.00019 σ_λ=.00093	σ_u=.00019 σ_λ=.00094	σ_u=.00019 σ_λ=.00094	σ_u=.00019 σ_λ=.00094	σ_u=.00019 σ_λ=.00094	σ_u=.00019 σ_λ=.00094	σ_u=.00019 σ_λ=.00094	σ_u=.00019 σ_λ=.00094
MOON RADIUS	σ_u=.00014 σ_λ=.00023	σ_u=.00239 σ_λ=.00134	σ_u=.00022 σ_λ=.00027	σ_u=.00237 σ_λ=.00131	σ_u=.00232 σ_λ=.00123	σ_u=.00211 σ_λ=.00088	σ_u=.00065 σ_λ=.00092	σ_u=.00260 σ_λ=.00114	σ_u=.00253 σ_λ=.00069

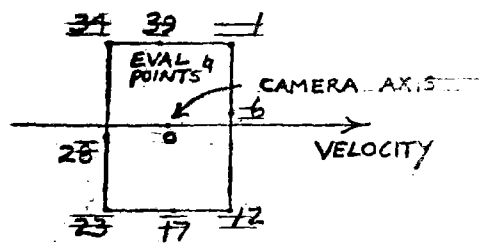
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00803° .241 KM σ_λ=.00511° .154 KM	σ_u=.00767° .231 KM σ_λ=.00924° .280 KM	σ_u=.00578° .174 KM σ_λ=.00721° .220 KM	σ_u=.00998° .300 KM σ_λ=.00744° .220 KM	σ_u=.01097° .330 KM σ_λ=.00560° .170 KM	σ_u=.01254° .375 KM σ_λ=.00778° .234 KM	σ_u=.01051° .315 KM σ_λ=.00705° .217 KM	σ_u=.01330° .400 KM σ_λ=.00716° .215 KM	σ_u=.01059° .319 KM σ_λ=.00657° .199 KM
NAVIGATION	σ_u=.00325 σ_λ=.00376	σ_u=.00336 σ_λ=.00358	σ_u=.00324 σ_λ=.00362	σ_u=.00314 σ_λ=.00361	σ_u=.00315 σ_λ=.00379	σ_u=.00316 σ_λ=.00377	σ_u=.00327 σ_λ=.00394	σ_u=.00344 σ_λ=.00390	σ_u=.00340 σ_λ=.00374
ATTITUDE	σ_u=.00733 σ_λ=.00332	σ_u=.00510 σ_λ=.00593	σ_u=.00477 σ_λ=.00393	σ_u=.00711 σ_λ=.00527	σ_u=.00897 σ_λ=.00378	σ_u=.01137 σ_λ=.00377	σ_u=.00997 σ_λ=.00372	σ_u=.01106 σ_λ=.00500	σ_u=.00828 σ_λ=.00523
CAMERA ON-TIME	σ_u=.00019 σ_λ=.00094	σ_u=.00019 σ_λ=.00093	σ_u=.00019 σ_λ=.00093	σ_u=.00019 σ_λ=.00093	σ_u=.00018 σ_λ=.00094	σ_u=.00018 σ_λ=.00095	σ_u=.00019 σ_λ=.00095	σ_u=.00020 σ_λ=.00094	σ_u=.00020 σ_λ=.00094
MOON RADIUS	σ_u=.00014 σ_λ=.00023	σ_u=.00462 σ_λ=.00604	σ_u=.00038 σ_λ=.00492	σ_u=.00626 σ_λ=.00364	σ_u=.00532 σ_λ=.00333	σ_u=.00425 σ_λ=.00545	σ_u=.00065 σ_λ=.00941	σ_u=.00654 σ_λ=.00319	σ_u=.00565 σ_λ=.00099

* σ_u = LATITUDE σ_λ = LONGITUDE

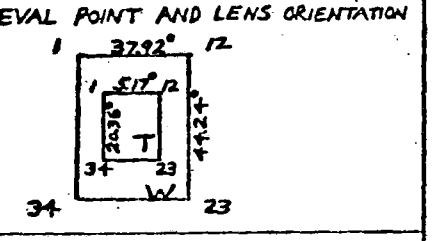
ERROR ANALYSIS RESULTS MISSION I FRAME 103





S/C ALTITUDE = 663 KM
TRUE ANOMALY = 345 °
INCLINATION ≈ 115 °
NOTE:

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

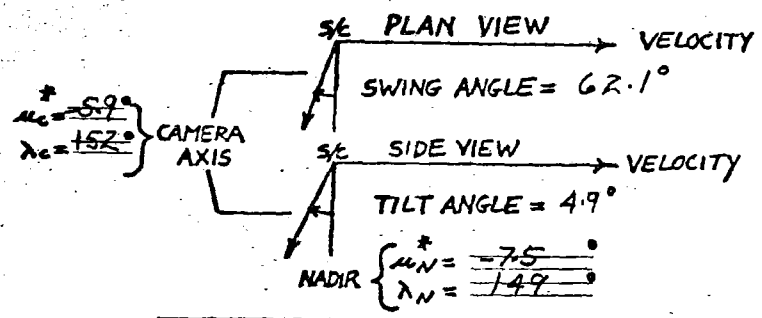
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .01090° .330 KM, $\nabla\lambda$ = .00648° .196 KM	∇u = .01106° .335 KM, $\nabla\lambda$ = .00661° .200 KM	∇u = .01057° .320 KM, $\nabla\lambda$ = .00642° .194 KM	∇u = .01123° .340 KM, $\nabla\lambda$ = .00670° .203 KM	∇u = .01156° .350 KM, $\nabla\lambda$ = .00674° .205 KM	∇u = .01198° .362 KM, $\nabla\lambda$ = .00687° .208 KM	∇u = .01126° .342 KM, $\nabla\lambda$ = .00664° .201 KM	∇u = .01168° .354 KM, $\nabla\lambda$ = .00680° .206 KM	∇u = .01139° .345 KM, $\nabla\lambda$ = .00667° .202 KM
NAVIGATION	∇u = .00701, $\nabla\lambda$ = .00420	∇u = .00831, $\nabla\lambda$ = .00441	∇u = .00714, $\nabla\lambda$ = .00412	∇u = .00870, $\nabla\lambda$ = .00441	∇u = .00866, $\nabla\lambda$ = .00421	∇u = .00561, $\nabla\lambda$ = .00399	∇u = .00687, $\nabla\lambda$ = .00400	∇u = .00833, $\nabla\lambda$ = .00400	∇u = .00832, $\nabla\lambda$ = .00418
ATTITUDE	∇u = .00803, $\nabla\lambda$ = .00410	∇u = .00728, $\nabla\lambda$ = .00438	∇u = .00712, $\nabla\lambda$ = .00405	∇u = .00835, $\nabla\lambda$ = .00444	∇u = .00801, $\nabla\lambda$ = .00445	∇u = .00938, $\nabla\lambda$ = .00448	∇u = .00837, $\nabla\lambda$ = .00417	∇u = .00818, $\nabla\lambda$ = .00450	∇u = .00777, $\nabla\lambda$ = .00444
CAMERA ON-TIME	∇u = .00036, $\nabla\lambda$ = .00183	∇u = .00038, $\nabla\lambda$ = .00182	∇u = .00036, $\nabla\lambda$ = .00182	∇u = .00033, $\nabla\lambda$ = .00182	∇u = .00033, $\nabla\lambda$ = .00183	∇u = .00033, $\nabla\lambda$ = .00184	∇u = .00035, $\nabla\lambda$ = .00183	∇u = .00038, $\nabla\lambda$ = .00183	∇u = .00038, $\nabla\lambda$ = .00183
MOON RADIUS	∇u = .00225, $\nabla\lambda$ = .00206	∇u = .00019, $\nabla\lambda$ = .00134	∇u = .00204, $\nabla\lambda$ = .00142	∇u = .00489, $\nabla\lambda$ = .00153	∇u = .00490, $\nabla\lambda$ = .00212	∇u = .00491, $\nabla\lambda$ = .00285	∇u = .00247, $\nabla\lambda$ = .00271	∇u = .00224, $\nabla\lambda$ = .00258	∇u = .00022, $\nabla\lambda$ = .00201

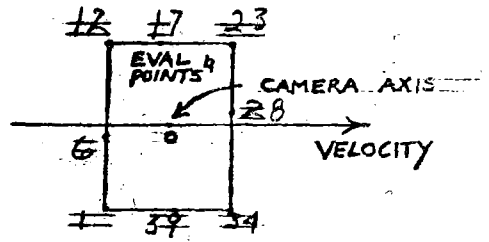
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .012 DG° .365 KM, $\nabla\lambda$ = .00659° .199 KM	∇u = .01161° .352 KM, $\nabla\lambda$ = .00924° .280 KM	∇u = .00932° .282 KM, $\nabla\lambda$ = .00799° .241 KM	∇u = .01234° .374 KM, $\nabla\lambda$ = .01017° .308 KM	∇u = .01556° .470 KM, $\nabla\lambda$ = .00819° .247 KM	∇u = .02098° .632 KM, $\nabla\lambda$ = .01103° .335 KM	∇u = .01601° .480 KM, $\nabla\lambda$ = .01004° .304 KM	∇u = .01740° .526 KM, $\nabla\lambda$ = .01037° .313 KM	∇u = .01432° .434 KM, $\nabla\lambda$ = .00792° .240 KM
NAVIGATION	∇u = .00701, $\nabla\lambda$ = .00420	∇u = .00965, $\nabla\lambda$ = .00591	∇u = .00733, $\nabla\lambda$ = .00597	∇u = .00412, $\nabla\lambda$ = .00605	∇u = .00395, $\nabla\lambda$ = .00433	∇u = .00307, $\nabla\lambda$ = .00379	∇u = .00653, $\nabla\lambda$ = .00369	∇u = .01036, $\nabla\lambda$ = .00362	∇u = .00997, $\nabla\lambda$ = .00407
ATTITUDE	∇u = .00955, $\nabla\lambda$ = .00426	∇u = .00580, $\nabla\lambda$ = .00641	∇u = .00543, $\nabla\lambda$ = .00431	∇u = .00795, $\nabla\lambda$ = .00752	∇u = .01240, $\nabla\lambda$ = .00643	∇u = .01863, $\nabla\lambda$ = .00622	∇u = .01436, $\nabla\lambda$ = .00550	∇u = .01353, $\nabla\lambda$ = .00682	∇u = .00977, $\nabla\lambda$ = .00615
CAMERA ON-TIME	∇u = .00036, $\nabla\lambda$ = .00183	∇u = .00040, $\nabla\lambda$ = .00179	∇u = .00036, $\nabla\lambda$ = .00179	∇u = .00032, $\nabla\lambda$ = .00179	∇u = .00030, $\nabla\lambda$ = .00182	∇u = .00028, $\nabla\lambda$ = .00190	∇u = .00035, $\nabla\lambda$ = .00189	∇u = .00042, $\nabla\lambda$ = .00189	∇u = .00041, $\nabla\lambda$ = .00183
MOON RADIUS	∇u = .00225, $\nabla\lambda$ = .00206	∇u = .00281, $\nabla\lambda$ = .00251	∇u = .00187, $\nabla\lambda$ = .00256	∇u = .00833, $\nabla\lambda$ = .00266	∇u = .00853, $\nabla\lambda$ = .00190	∇u = .00892, $\nabla\lambda$ = .00805	∇u = .00271, $\nabla\lambda$ = .00730	∇u = .00352, $\nabla\lambda$ = .00665	∇u = .00317, $\nabla\lambda$ = .00223

* u = LATITUDE λ = LONGITUDE

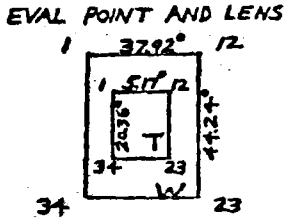
ERROR ANALYSIS RESULTS MISSION I FRAME 116





S/C ALTITUDE = 1454 KM
TRUE ANOMALY = 138 °
INCLINATION ≈ 11.5 °
NOTE: R(180°) P(0°) Y(0°)

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

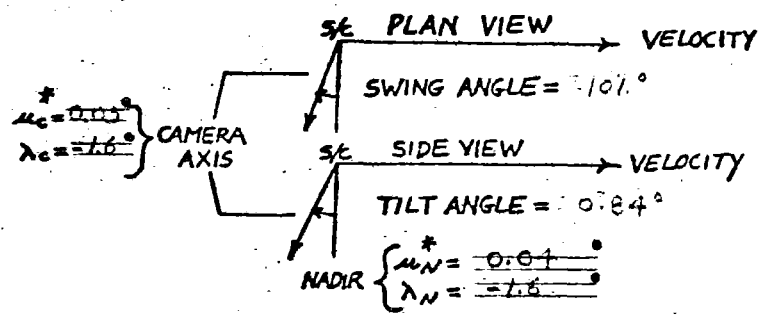
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.22779° 6.93 KM / σ_λ=.09704° 2.94 KM	σ_u=.23090° 3.95 KM / σ_λ=.11140° 3.36 KM	σ_u=.22081° 6.70 KM / σ_λ=.09635° .295 KM	σ_u=.25189° 7.63 KM / σ_λ=.10031° .03 KM	σ_u=.25791° 7.90 KM / σ_λ=.10155° 3.20 KM	σ_u=.26634° 8.09 KM / σ_λ=.10466° 3.06 KM	σ_u=.23578° 7.17 KM / σ_λ=.09911° 3.00 KM	σ_u=.24527° 7.42 KM / σ_λ=.11250° 3.40 KM	σ_u=.23832° 7.23 KM / σ_λ=.11190° 3.35 KM
NAVIGATION	σ_u=.00594 / σ_λ=.00110	σ_u=.00609 / σ_λ=.00112	σ_u=.00594 / σ_λ=.00108	σ_u=.00628 / σ_λ=.00104	σ_u=.00627 / σ_λ=.00104	σ_u=.00626 / σ_λ=.00104	σ_u=.00594 / σ_λ=.00112	σ_u=.00611 / σ_λ=.00126	σ_u=.00610 / σ_λ=.00118
ATTITUDE	σ_u=.22765 / σ_λ=.09701	σ_u=.23079 / σ_λ=.11139	σ_u=.22073 / σ_λ=.09634	σ_u=.25175 / σ_λ=.10029	σ_u=.25778 / σ_λ=.10151	σ_u=.26621 / σ_λ=.10459	σ_u=.23570 / σ_λ=.09905	σ_u=.24516 / σ_λ=.11245	σ_u=.23821 / σ_λ=.11137
CAMERA ON-TIME	σ_u=.00020 / σ_λ=.00106	σ_u=.00014 / σ_λ=.00106	σ_u=.00019 / σ_λ=.00104	σ_u=.00028 / σ_λ=.00105	σ_u=.00029 / σ_λ=.00107	σ_u=.00031 / σ_λ=.00111	σ_u=.00021 / σ_λ=.00109	σ_u=.00139 / σ_λ=.00111	σ_u=.00014 / σ_λ=.00109
MOON RADIUS	σ_u=.00084 / σ_λ=.00193	σ_u=.00246 / σ_λ=.00052	σ_u=.00052 / σ_λ=.00080	σ_u=.00560 / σ_λ=.00194	σ_u=.00557 / σ_λ=.00231	σ_u=.00537 / σ_λ=.00365	σ_u=.00119 / σ_λ=.00311	σ_u=.00368 / σ_λ=.00292	σ_u=.00358 / σ_λ=.00181

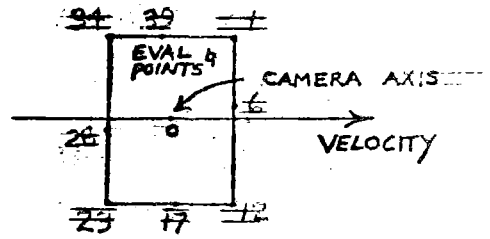
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.25270° 7.66 KM / σ_λ=.10040° 3.05 KM	σ_u=.30430° 9.20 KM / σ_λ=.28083° 8.52 KM	σ_u=.20755° 6.26 KM / σ_λ=.12095° 3.65 KM	σ_u=.45884° 13.9 KM / σ_λ=.26318° 8.00 KM	σ_u=.45773° 13.8 KM / σ_λ=.14633° 4.44 KM	σ_u=.14605° 44.3 KM / σ_λ=1.5646° 47.3 KM	σ_u=.35912° 10.9 KM / σ_λ=.17319° 5.25 KM	σ_u=.58659° 15.0 KM / σ_λ=.38546° 11.7 KM	σ_u=.36914° 11.2 KM / σ_λ=.17194° 5.22 KM
NAVIGATION	σ_u=.00594 / σ_λ=.00110	σ_u=.00700 / σ_λ=.00166	σ_u=.00576 / σ_λ=.00107	σ_u=.00909 / σ_λ=.00266	σ_u=.00820 / σ_λ=.00103	σ_u=.01551 / σ_λ=.01474	σ_u=.00591 / σ_λ=.00156	σ_u=.00852 / σ_λ=.00624	σ_u=.00726 / σ_λ=.00149
ATTITUDE	σ_u=.25263 / σ_λ=.10037	σ_u=.30406 / σ_λ=.28060	σ_u=.20746 / σ_λ=.12024	σ_u=.45839 / σ_λ=.26277	σ_u=.45741 / σ_λ=.14629	σ_u=.14595 / σ_λ=1.5627	σ_u=.35907 / σ_λ=.17259	σ_u=.58631 / σ_λ=.38456	σ_u=.36891 / σ_λ=.17191
CAMERA ON-TIME	σ_u=.00021 / σ_λ=.00106	σ_u=.00016 / σ_λ=.00122	σ_u=.00015 / σ_λ=.00104	σ_u=.00027 / σ_λ=.00105	σ_u=.00051 / σ_λ=.00114	σ_u=.00253 / σ_λ=.00642	σ_u=.00030 / σ_λ=.00157	σ_u=.00022 / σ_λ=.00205	σ_u=.00005 / σ_λ=.00118
MOON RADIUS	σ_u=.00084 / σ_λ=.00193	σ_u=.00989 / σ_λ=.01104	σ_u=.00088 / σ_λ=.00682	σ_u=.01818 / σ_λ=.01011	σ_u=.01517 / σ_λ=.00303	σ_u=.05080 / σ_λ=.07606	σ_u=.00201 / σ_λ=.01422	σ_u=.01614 / σ_λ=.02555	σ_u=.01087 / σ_λ=.00279

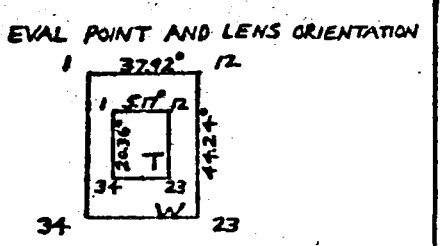
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION I FRAME 125





S/C ALTITUDE = 511 KM
TRUE ANOMALY = 355.7°
INCLINATION ≈ 11.5°
NOTE: t16



TELEPHOTO LENS, T

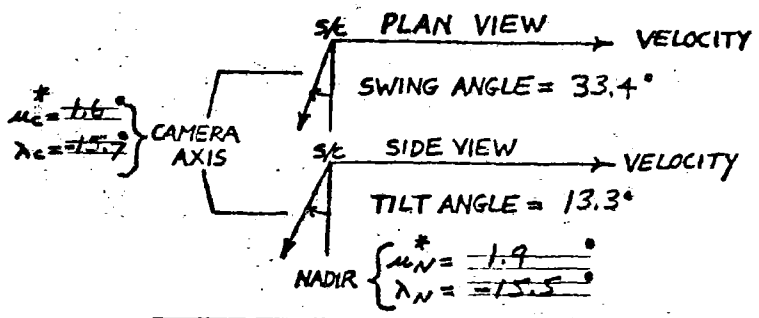
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u=.00587° .178 KM ∇_λ=.00320° .097 KM	∇_u=.00604° .184 KM ∇_λ=.00367° .112 KM	∇_u=.00560° .170 KM ∇_λ=.00324° .098 KM	∇_u=.00649° .197 KM ∇_λ=.00321° .095 KM	∇_u=.00664° .202 KM ∇_λ=.00325° .099 KM	∇_u=.00696° .207 KM ∇_λ=.00394° .140 KM	∇_u=.00615° .186 KM ∇_λ=.00330° .100 KM	∇_u=.00663° .202 KM ∇_λ=.00357° .108 KM	∇_u=.00737° .224 KM ∇_λ=.00356° .108 KM
NAVIGATION	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0
ATTITUDE	∇_u=.00587 ∇_λ=.00305	∇_u=.00557 ∇_λ=.00342	∇_u=.00559 ∇_λ=.00307	∇_u=.00602 ∇_λ=.00306	∇_u=.00624 ∇_λ=.00305	∇_u=.00651 ∇_λ=.00305	∇_u=.00615 ∇_λ=.00306	∇_u=.00613 ∇_λ=.00343	∇_u=.00587 ∇_λ=.00342
CAMERA ON-TIME	∇_u=.00020 ∇_λ=.00093	∇_u=.00020 ∇_λ=.00093	∇_u=.00020 ∇_λ=.00093	∇_u=.00020 ∇_λ=.00013	∇_u=.00020 ∇_λ=.00094	∇_u=.00020 ∇_λ=.00094	∇_u=.00020 ∇_λ=.00094	∇_u=.00021 ∇_λ=.00094	∇_u=.00020 ∇_λ=.00093
MOON RADIUS	∇_u=.00008 ∇_λ=.00018	∇_u=.00232 ∇_λ=.00092	∇_u=.00016 ∇_λ=.00046	∇_u=.00242 ∇_λ=.00007	∇_u=.00023 ∇_λ=.00069	∇_u=.00217 ∇_λ=.00129	∇_u=.00001 ∇_λ=.00083	∇_u=.00258 ∇_λ=.00027	∇_u=.00247 ∇_λ=.00027

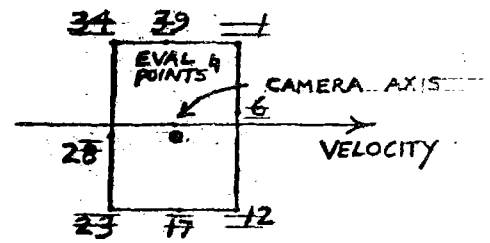
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u=.00696° .211 KM ∇_λ=.00332° .101 KM	∇_u=.00665° .201 KM ∇_λ=.00777° .235 KM	∇_u=.00464° .140 KM ∇_λ=.00574° .174 KM	∇_u=.00921° .280 KM ∇_λ=.00589° .178 KM	∇_u=.01006° .305 KM ∇_λ=.00397° .120 KM	∇_u=.01163° .352 KM ∇_λ=.00706° .214 KM	∇_u=.00943° .286 KM ∇_λ=.00615° .187 KM	∇_u=.01226° .375 KM ∇_λ=.00601° .182 KM	∇_u=.00958° .290 KM ∇_λ=.00494° .150 KM
NAVIGATION	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0
ATTITUDE	∇_u=.00696 ∇_λ=.00318	∇_u=.00490 ∇_λ=.00538	∇_u=.00461 ∇_λ=.00550	∇_u=.00675 ∇_λ=.00485	∇_u=.00749 ∇_λ=.00375	∇_u=.01077 ∇_λ=.00370	∇_u=.00941 ∇_λ=.00364	∇_u=.01038 ∇_λ=.00471	∇_u=.00779 ∇_λ=.00482
CAMERA ON-TIME	∇_u=.00020 ∇_λ=.00093	∇_u=.00020 ∇_λ=.00093	∇_u=.00020 ∇_λ=.00094	∇_u=.00020 ∇_λ=.00093	∇_u=.00023 ∇_λ=.00094	∇_u=.00019 ∇_λ=.00095	∇_u=.00020 ∇_λ=.00094	∇_u=.00022 ∇_λ=.00094	∇_u=.00021 ∇_λ=.00093
MOON RADIUS	∇_u=.00008 ∇_λ=.00018	∇_u=.00449 ∇_λ=.00552	∇_u=.00043 ∇_λ=.00444	∇_u=.00627 ∇_λ=.00321	∇_u=.00539 ∇_λ=.00094	∇_u=.00937 ∇_λ=.00594	∇_u=.00059 ∇_λ=.00486	∇_u=.00651 ∇_λ=.00362	∇_u=.00557 ∇_λ=.00057

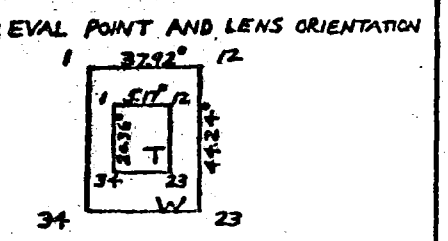
* ν = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION I FRAME 135





S/C ALTITUDE = 541 KM
TRUE ANOMALY = 346 °
INCLINATION = 11.5 °
NOTE:



TELEPHOTO LENS, T

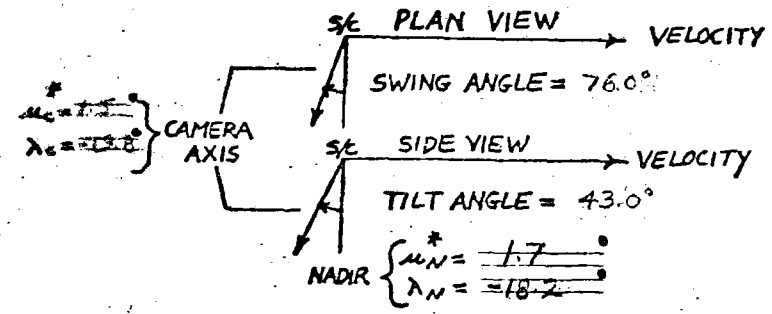
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00727° (.220 KM) σ_λ = .00578° (.175 KM)	σ_u = .00614° (.196 KM) σ_λ = .00570° (.173 KM)	σ_u = .00681° (.206 KM) σ_λ = .00556° (.169 KM)	σ_u = .00856° (.258 KM) σ_λ = .00579° (.175 KM)	σ_u = .00916° (.278 KM) σ_λ = .00577° (.181 KM)	σ_u = .00954° (.289 KM) σ_λ = .00627° (.190 KM)	σ_u = .00775° (.235 KM) σ_λ = .00606° (.184 KM)	σ_u = .00683° (.207 KM) σ_λ = .00615° (.186 KM)	σ_u = .00651° (.196 KM) σ_λ = .00591° (.179 KM)
NAVIGATION	σ_u = .00156 σ_λ = .00391	σ_u = .00154 σ_λ = .00389	σ_u = .00156 σ_λ = .00389	σ_u = .00159 σ_λ = .00390	σ_u = .00157 σ_λ = .00392	σ_u = .00159 σ_λ = .00394	σ_u = .00156 σ_λ = .00393	σ_u = .00154 σ_λ = .00393	σ_u = .00154 σ_λ = .00391
ATTITUDE	σ_u = .00660 σ_λ = .00335	σ_u = .00593 σ_λ = .00357	σ_u = .00618 σ_λ = .00331	σ_u = .00675 σ_λ = .00363	σ_u = .00732 σ_λ = .00363	σ_u = .00779 σ_λ = .00365	σ_u = .00704 σ_λ = .00341	σ_u = .00665 σ_λ = .00368	σ_u = .00632 σ_λ = .00362
CAMERA ON-TIME	σ_u = .00037 σ_λ = .00183	σ_u = .00039 σ_λ = .00182	σ_u = .00037 σ_λ = .00182	σ_u = .00034 σ_λ = .00182	σ_u = .00031 σ_λ = .00183	σ_u = .00034 σ_λ = .00184	σ_u = .00036 σ_λ = .00183	σ_u = .00039 σ_λ = .00183	σ_u = .00039 σ_λ = .00183
MOON RADIUS	σ_u = .00260 σ_λ = .00186	σ_u = .00017 σ_λ = .00113	σ_u = .00239 σ_λ = .00122	σ_u = .00585 σ_λ = .00135	σ_u = .00[illegible] σ_λ = .00194	σ_u = .00226 σ_λ = .00267	σ_u = .00282 σ_λ = .00252	σ_u = .00011 σ_λ = .00235	σ_u = .00114 σ_λ = .00179

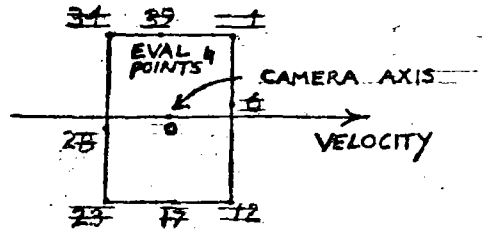
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00842° (.255 KM) σ_λ = .00585° (.177 KM)	σ_u = .00550° (.167 KM) σ_λ = .00721° (.218 KM)	σ_u = .00526° (.159 KM) σ_λ = .00614° (.186 KM)	σ_u = .01124° (.341 KM) σ_λ = .00807° (.244 KM)	σ_u = .01388° (.420 KM) σ_λ = .00763° (.213 KM)	σ_u = .01818° (.551 KM) σ_λ = .01037° (.314 KM)	σ_u = .01222° (.371 KM) σ_λ = .00947° (.287 KM)	σ_u = .01134° (.344 KM) σ_λ = .00951° (.288 KM)	σ_u = .00847° (.257 KM) σ_λ = .00691° (.209 KM)
NAVIGATION	σ_u = .00156 σ_λ = .00391	σ_u = .00152 σ_λ = .00379	σ_u = .00155 σ_λ = .00379	σ_u = .00163 σ_λ = .00378	σ_u = .00164 σ_λ = .00371	σ_u = .00167 σ_λ = .00412	σ_u = .00157 σ_λ = .00409	σ_u = .00152 σ_λ = .00406	σ_u = .00152 σ_λ = .00392
ATTITUDE	σ_u = .00785 σ_λ = .00348	σ_u = .00469 σ_λ = .00522	σ_u = .00448 σ_λ = .00355	σ_u = .00678 σ_λ = .00628	σ_u = .01048 σ_λ = .00527	σ_u = .01557 σ_λ = .00500	σ_u = .01173 σ_λ = .00448	σ_u = .01080 σ_λ = .00556	σ_u = .00785 σ_λ = .00501
CAMERA ON-TIME	σ_u = .00037 σ_λ = .00183	σ_u = .00041 σ_λ = .00179	σ_u = .00037 σ_λ = .00179	σ_u = .00033 σ_λ = .00179	σ_u = .00031 σ_λ = .00183	σ_u = .00029 σ_λ = .00189	σ_u = .00036 σ_λ = .00189	σ_u = .00042 σ_λ = .00188	σ_u = .00041 σ_λ = .00183
MOON RADIUS	σ_u = .00260 σ_λ = .00186	σ_u = .00241 σ_λ = .00269	σ_u = .00225 σ_λ = .00275	σ_u = .00880 σ_λ = .00286	σ_u = .00885 σ_λ = .00174	σ_u = .00923 σ_λ = .00787	σ_u = .00302 σ_λ = .00703	σ_u = .00310 σ_λ = .00628	σ_u = .00276 σ_λ = .00199

* σ_u = LATITUDE σ_λ = LONGITUDE

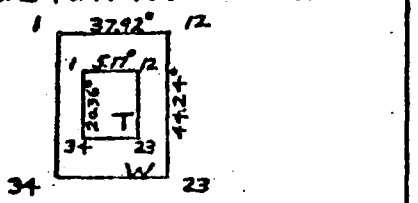
ERROR ANALYSIS RESULTS MISSION I FRAME 137





S/C ALTITUDE = 525 KM
TRUE ANOMALY = 346.8°
INCLINATION ≈ 11.5°
NOTE: APOLLO TGT.

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

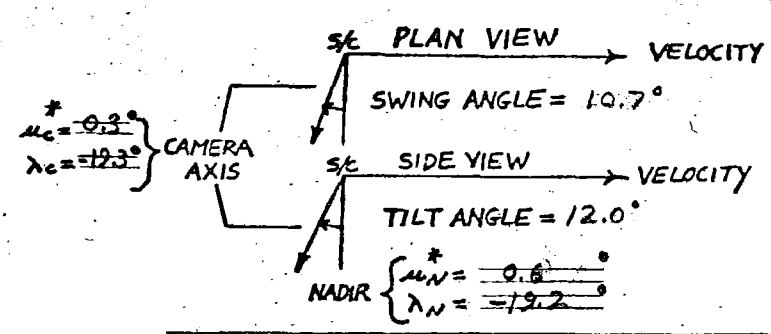
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00727° .220KM σ_λ=.01581° .480KM	σ_u=.00610° .185 KM σ_λ=.01432° .435 KM	σ_u=.00657° .199 KM σ_λ=.01466° .443 KM	σ_u=.00884° .268 KM σ_λ=.01540° .468 KM	σ_u=.00948° .286 KM σ_λ=.01648° .500 KM	σ_u=.01020° .310 KM σ_λ=.01799° .590 KM	σ_u=.00805° .245 KM σ_λ=.01714° .520 KM	σ_u=.00728° .221 KM σ_λ=.01653° .500 KM	σ_u=.00671° .209 KM σ_λ=.01546° .470 KM
NAVIGATION	σ_u=.00129 σ_λ=.00634	σ_u=.00122 σ_λ=.00646	σ_u=.00128 σ_λ=.00644	σ_u=.00138 σ_λ=.00641	σ_u=.00140 σ_λ=.00630	σ_u=.00143 σ_λ=.00614	σ_u=.00131 σ_λ=.00620	σ_u=.00120 σ_λ=.00625	σ_u=.00121 σ_λ=.00638
ATTITUDE	σ_u=.00692 σ_λ=.00644	σ_u=.00581 σ_λ=.00609	σ_u=.00626 σ_λ=.00589	σ_u=.00697 σ_λ=.00628	σ_u=.00761 σ_λ=.00680	σ_u=.00845 σ_λ=.00755	σ_u=.00766 σ_λ=.00711	σ_u=.00696 σ_λ=.00723	σ_u=.00641 σ_λ=.00666
CAMERA ON-TIME	σ_u=.00037 σ_λ=.00196	σ_u=.00040 σ_λ=.00194	σ_u=.00037 σ_λ=.00194	σ_u=.00033 σ_λ=.00195	σ_u=.00033 σ_λ=.00197	σ_u=.00032 σ_λ=.00199	σ_u=.00036 σ_λ=.00198	σ_u=.00041 σ_λ=.00197	σ_u=.00041 σ_λ=.00196
MOON RADIUS	σ_u=.00177 σ_λ=.01283	σ_u=.00135 σ_λ=.01108	σ_u=.00151 σ_λ=.01161	σ_u=.00525 σ_λ=.01236	σ_u=.00536 σ_λ=.01349	σ_u=.00551 σ_λ=.01499	σ_u=.00205 σ_λ=.01417	σ_u=.00171 σ_λ=.01334	σ_u=.00154 σ_λ=.01226

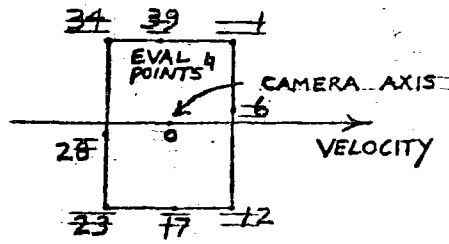
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00852° .261KM σ_λ=.01592° .482KM	σ_u=.00497° .151 KM σ_λ=.01037° .315 KM	σ_u=.00434° .132KM σ_λ=.01012° .306 KM	σ_u=.00975° .295 KM σ_λ=.01144° .345 KM	σ_u=.01436° .437 KM σ_λ=.01747° .530 KM	σ_u=.03151° .956 KM σ_λ=.04434° 1.34 KM	σ_u=.01785° .542 KM σ_λ=.03418° 1.04 KM	σ_u=.01654° .500 KM σ_λ=.02997° .910 KM	σ_u=.00926° .281 KM σ_λ=.01628° .495 KM
NAVIGATION	σ_u=.00129 σ_λ=.00634	σ_u=.00120 σ_λ=.00679	σ_u=.00126 σ_λ=.00680	σ_u=.00136 σ_λ=.00678	σ_u=.00158 σ_λ=.00628	σ_u=.00367 σ_λ=.00192	σ_u=.00144 σ_λ=.00370	σ_u=.00109 σ_λ=.00492	σ_u=.00112 σ_λ=.00631
ATTITUDE	σ_u=.00822 σ_λ=.00669	σ_u=.00336 σ_λ=.00538	σ_u=.00384 σ_λ=.00415	σ_u=.00480 σ_λ=.00593	σ_u=.00990 σ_λ=.00835	σ_u=.02644 σ_λ=.02624	σ_u=.01762 σ_λ=.01880	σ_u=.01368 σ_λ=.01770	σ_u=.00731 σ_λ=.00857
CAMERA ON-TIME	σ_u=.00037 σ_λ=.00196	σ_u=.00042 σ_λ=.00187	σ_u=.00038 σ_λ=.00187	σ_u=.00031 σ_λ=.00188	σ_u=.00027 σ_λ=.00197	σ_u=.00010 σ_λ=.00142	σ_u=.00035 σ_λ=.00227	σ_u=.00053 σ_λ=.00218	σ_u=.00046 σ_λ=.00196
MOON RADIUS	σ_u=.00177 σ_λ=.01283	σ_u=.00343 σ_λ=.00539	σ_u=.00152 σ_λ=.00595	σ_u=.00837 σ_λ=.00680	σ_u=.01028 σ_λ=.01387	σ_u=.01675 σ_λ=.03560	σ_u=.00241 σ_λ=.02822	σ_u=.00921 σ_λ=.02369	σ_u=.00556 σ_λ=.01216

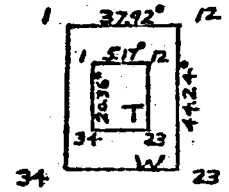
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION I FRAME 139





S/C ALTITUDE = 46.3 KM
TRUE ANOMALY = 351 °
INCLINATION ≈ 11.5 °
NOTE:



TELEPHOTO LENS, T

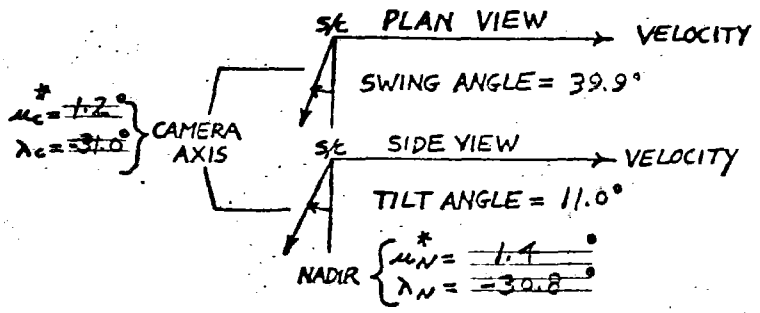
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u = .00644° .195 KM ∇_λ = .00373° .113 KM	∇_u = .00525° .159 KM ∇_λ = .00383° .116 KM	∇_u = .00605° .183 KM ∇_λ = .00366° .111 KM	∇_u = .00824° .250 KM ∇_λ = .00383° .118 KM	∇_u = .00845° .256 KM ∇_λ = .00393° .119 KM	∇_u = .00871° .264 KM ∇_λ = .00411° .124 KM	∇_u = .00683° .207 KM ∇_λ = .00392° .119 KM	∇_u = .00579° .175 KM ∇_λ = .00403° .122 KM	∇_u = .00555° .168 KM ∇_λ = .00389° .118 KM
NAVIGATION	∇_u = .00132 ∇_λ = .00146	∇_u = .00132 ∇_λ = .00146	∇_u = .00132 ∇_λ = .00146	∇_u = .00133 ∇_λ = .00146	∇_u = .00133 ∇_λ = .00147	∇_u = .00133 ∇_λ = .00147	∇_u = .00132 ∇_λ = .00147	∇_u = .00132 ∇_λ = .00147	∇_u = .00132 ∇_λ = .00146
ATTITUDE	∇_u = .00583 ∇_λ = .00286	∇_u = .00505 ∇_λ = .00304	∇_u = .00529 ∇_λ = .00282	∇_u = .00602 ∇_λ = .00310	∇_u = .00632 ∇_λ = .00307	∇_u = .00663 ∇_λ = .00305	∇_u = .00598 ∇_λ = .00285	∇_u = .00562 ∇_λ = .00308	∇_u = .00526 ∇_λ = .00305
CAMERA ON-TIME	∇_u = .00035 ∇_λ = .00182	∇_u = .00039 ∇_λ = .00182	∇_u = .00033 ∇_λ = .00182	∇_u = .00036 ∇_λ = .00182	∇_u = .00036 ∇_λ = .00182	∇_u = .00036 ∇_λ = .00183	∇_u = .00037 ∇_λ = .00183	∇_u = .00039 ∇_λ = .00183	∇_u = .00039 ∇_λ = .00182
MOON RADIUS	∇_u = .00279 ∇_λ = .00067	∇_u = .00039 ∇_λ = .00006	∇_u = .00259 ∇_λ = .00004	∇_u = .00546 ∇_λ = .00016	∇_u = .00544 ∇_λ = .00075	∇_u = .00541 ∇_λ = .00146	∇_u = .00300 ∇_λ = .00130	∇_u = .00033 ∇_λ = .00114	∇_u = .00056 ∇_λ = .00059

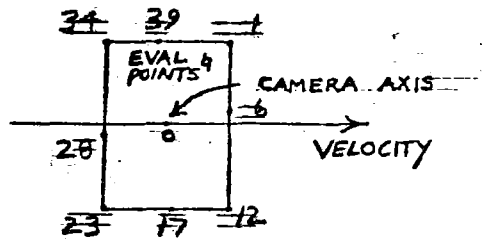
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u = .00738° .224 KM ∇_λ = .00381° .115 KM	∇_u = .00488° .148 KM ∇_λ = .00650° .197 KM	∇_u = .00497° .148 KM ∇_λ = .00561° .170 KM	∇_u = .01133° .344 KM ∇_λ = .00744° .226 KM	∇_u = .01309° .396 KM ∇_λ = .00508° .154 KM	∇_u = .01589° .481 KM ∇_λ = .00783° .237 KM	∇_u = .01025° .310 KM ∇_λ = .00701° .212 KM	∇_u = .00940° .285 KM ∇_λ = .00698° .211 KM	∇_u = .00725° .220 KM ∇_λ = .00487° .148 KM
NAVIGATION	∇_u = .00132 ∇_λ = .00146	∇_u = .00132 ∇_λ = .00143	∇_u = .00132 ∇_λ = .00143	∇_u = .00134 ∇_λ = .00143	∇_u = .00135 ∇_λ = .00146	∇_u = .00135 ∇_λ = .00152	∇_u = .00132 ∇_λ = .00151	∇_u = .00132 ∇_λ = .00150	∇_u = .00132 ∇_λ = .00147
ATTITUDE	∇_u = .00669 ∇_λ = .00294	∇_u = .00413 ∇_λ = .00464	∇_u = .00394 ∇_λ = .00318	∇_u = .00634 ∇_λ = .00572	∇_u = .00926 ∇_λ = .00448	∇_u = .01299 ∇_λ = .00391	∇_u = .00967 ∇_λ = .00355	∇_u = .00889 ∇_λ = .00444	∇_u = .00666 ∇_λ = .00420
CAMERA ON-TIME	∇_u = .00038 ∇_λ = .00182	∇_u = .00040 ∇_λ = .00180	∇_u = .00038 ∇_λ = .00180	∇_u = .00036 ∇_λ = .00180	∇_u = .00035 ∇_λ = .00182	∇_u = .00033 ∇_λ = .00186	∇_u = .00037 ∇_λ = .00186	∇_u = .00041 ∇_λ = .00185	∇_u = .00040 ∇_λ = .00182
MOON RADIUS	∇_u = .00279 ∇_λ = .00067	∇_u = .00222 ∇_λ = .00392	∇_u = .00252 ∇_λ = .00400	∇_u = .00929 ∇_λ = .00417	∇_u = .00715 ∇_λ = .00054	∇_u = .00904 ∇_λ = .00634	∇_u = .00316 ∇_λ = .00555	∇_u = .00274 ∇_λ = .00482	∇_u = .00250 ∇_λ = .00077

* u = LATITUDE λ = LONGITUDE

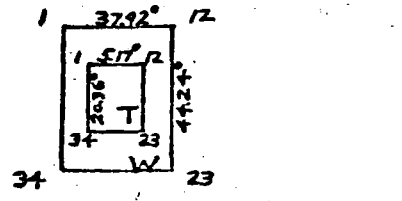
ERROR ANALYSIS RESULTS MISSION I FRAME 150





S/C ALTITUDE = 535 KM
TRUE ANOMALY = 347 °
INCLINATION ≈ 11.5 °
NOTE:

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

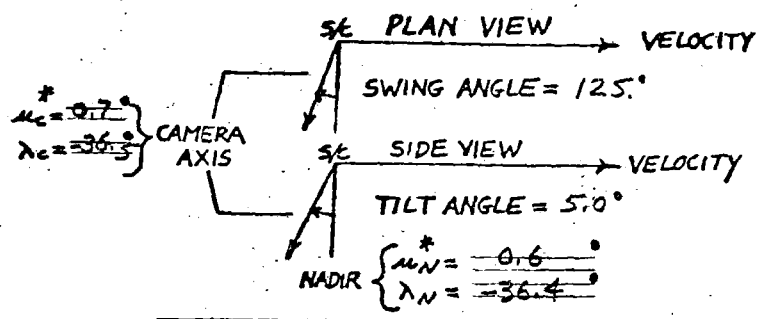
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .00708° .214 KM σ_λ = .00998° .302 KM	σ_μ = .00625° .189 KM σ_λ = .00990° .300 KM	σ_μ = .00662° .201 KM σ_λ = .00984° .298 KM	σ_μ = .00833° .252 KM σ_λ = .01004° .303 KM	σ_μ = .00365° .262 KM σ_λ = .01015° .309 KM	σ_μ = .00906° .275 KM σ_λ = .01035° .314 KM	σ_μ = .00756° .229 KM σ_λ = .01017° .308 KM	σ_μ = .00700° .212 KM σ_λ = .01020° .309 KM	σ_μ = .00666° .202 KM σ_λ = .01004° .303 KM
NAVIGATION	σ_μ = .00152 σ_λ = .00806	σ_μ = .00151 σ_λ = .00804	σ_μ = .00152 σ_λ = .00804	σ_μ = .00153 σ_λ = .00804	σ_μ = .00153 σ_λ = .00806	σ_μ = .00153 σ_λ = .00809	σ_μ = .00152 σ_λ = .00808	σ_μ = .00151 σ_λ = .00808	σ_μ = .00151 σ_λ = .00806
ATTITUDE	σ_μ = .00661 σ_λ = .00531	σ_μ = .00604 σ_λ = .00539	σ_μ = .00618 σ_λ = .00525	σ_μ = .00680 σ_λ = .00560	σ_μ = .00719 σ_λ = .00563	σ_μ = .00766 σ_λ = .00568	σ_μ = .00706 σ_λ = .00540	σ_μ = .00681 σ_λ = .00551	σ_μ = .00645 σ_λ = .00544
CAMERA ON-TIME	σ_μ = .00037 σ_λ = .00183	σ_μ = .00039 σ_λ = .00182	σ_μ = .00037 σ_λ = .00182	σ_μ = .00035 σ_λ = .00182	σ_μ = .00035 σ_λ = .00183	σ_μ = .00035 σ_λ = .00183	σ_μ = .00037 σ_λ = .00183	σ_μ = .00037 σ_λ = .00183	σ_μ = .00039 σ_λ = .00183
MOON RADIUS	σ_μ = .00198 σ_λ = .00173	σ_μ = .00044 σ_λ = .00104	σ_μ = .00176 σ_λ = .00110	σ_μ = .00459 σ_λ = .00118	σ_μ = .00456 σ_λ = .00176	σ_μ = .00457 σ_λ = .00247	σ_μ = .00219 σ_λ = .00237	σ_μ = .00048 σ_λ = .00226	σ_μ = .00046 σ_λ = .00171

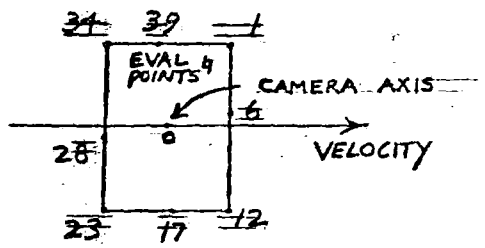
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .00819° .248 KM σ_λ = .01002° .303 KM	σ_μ = .00596° .180 KM σ_λ = .01100° .333 KM	σ_μ = .00495° .150 KM σ_λ = .01024° .310 KM	σ_μ = .01027° .311 KM σ_λ = .01166° .353 KM	σ_μ = .01287° .390 KM σ_λ = .01094° .332 KM	σ_μ = .01717° .520 KM σ_λ = .01359° .411 KM	σ_μ = .01211° .367 KM σ_λ = .01279° .387 KM	σ_μ = .01203° .364 KM σ_λ = .01284° .389 KM	σ_μ = .00897° .272 KM σ_λ = .01070° .324 KM
NAVIGATION	σ_μ = .00152 σ_λ = .00806	σ_μ = .00152 σ_λ = .00793	σ_μ = .00151 σ_λ = .00793	σ_μ = .00155 σ_λ = .00792	σ_μ = .00156 σ_λ = .00805	σ_μ = .00158 σ_λ = .00830	σ_μ = .00152 σ_λ = .00828	σ_μ = .00152 σ_λ = .00825	σ_μ = .00152 σ_λ = .00807
ATTITUDE	σ_μ = .00780 σ_λ = .00539	σ_μ = .00485 σ_λ = .00681	σ_μ = .00443 σ_λ = .00554	σ_μ = .00638 σ_λ = .00782	σ_μ = .00991 σ_λ = .00702	σ_μ = .01490 σ_λ = .00757	σ_μ = .01176 σ_λ = .00671	σ_μ = .01134 σ_λ = .00733	σ_μ = .00815 σ_λ = .00649
CAMERA ON-TIME	σ_μ = .00037 σ_λ = .00183	σ_μ = .00041 σ_λ = .00179	σ_μ = .00038 σ_λ = .00179	σ_μ = .00034 σ_λ = .00179	σ_μ = .00032 σ_λ = .00182	σ_μ = .00031 σ_λ = .00185	σ_μ = .00036 σ_λ = .00188	σ_μ = .00042 σ_λ = .00188	σ_μ = .00042 σ_λ = .00183
MOON RADIUS	σ_μ = .00198 σ_λ = .00173	σ_μ = .00310 σ_λ = .00277	σ_μ = .00158 σ_λ = .00284	σ_μ = .00789 σ_λ = .00296	σ_μ = .00806 σ_λ = .00150	σ_μ = .00836 σ_λ = .00740	σ_μ = .00245 σ_λ = .00681	σ_μ = .00361 σ_λ = .00629	σ_μ = .00340 σ_λ = .00195

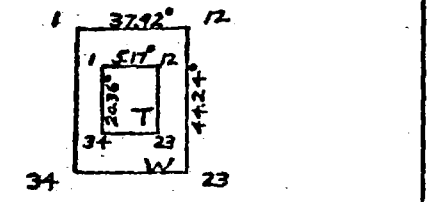
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION I FRAME 154





S/C ALTITUDE = 492 KM
TRUE ANOMALY = 35.6°
INCLINATION = 115°
NOTE:



TELEPHOTO LENS, T

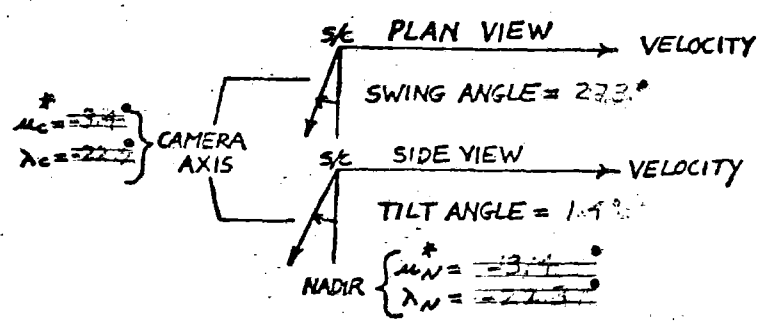
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00611° .135 KM σ_λ=.00539° .118 KM	σ_u=.00686° .208 KM σ_λ=.00396° .120 KM	σ_u=.00586° .178 KM σ_λ=.00378° .114 KM	σ_u=.00605° .184 KM σ_λ=.00403° .122 KM	σ_u=.00633° .192 KM σ_λ=.00398° .120 KM	σ_u=.00665° .202 KM σ_λ=.00431° .131 KM	σ_u=.00638° .194 KM σ_λ=.00413° .125 KM	σ_u=.00740° .224 KM σ_λ=.00430° .130 KM	σ_u=.00715° .216 KM σ_λ=.00403° .124 KM
NAVIGATION	σ_u=.00137 σ_λ=.00150	σ_u=.00138 σ_λ=.00148	σ_u=.00137 σ_λ=.00149	σ_u=.00136 σ_λ=.00149	σ_u=.00135 σ_λ=.00150	σ_u=.00135 σ_λ=.00150	σ_u=.00137 σ_λ=.00150	σ_u=.00138 σ_λ=.00150	σ_u=.00139 σ_λ=.00150
ATTITUDE	σ_u=.00591 σ_λ=.00295	σ_u=.00593 σ_λ=.00315	σ_u=.00561 σ_λ=.00293	σ_u=.00563 σ_λ=.00325	σ_u=.00531 σ_λ=.00325	σ_u=.00625 σ_λ=.00327	σ_u=.00621 σ_λ=.00298	σ_u=.00657 σ_λ=.00315	σ_u=.00628 σ_λ=.00314
CAMERA ON-TIME	σ_u=.00039 σ_λ=.00182	σ_u=.00041 σ_λ=.00182	σ_u=.00039 σ_λ=.00182	σ_u=.00038 σ_λ=.00182	σ_u=.00038 σ_λ=.00182	σ_u=.00038 σ_λ=.00183	σ_u=.00039 σ_λ=.00183	σ_u=.00041 σ_λ=.00183	σ_u=.00041 σ_λ=.00182
MOON RADIUS	σ_u=.00065 σ_λ=.00180	σ_u=.00312 σ_λ=.00048	σ_u=.00089 σ_λ=.00049	σ_u=.00114 σ_λ=.00030	σ_u=.00176 σ_λ=.00038	σ_u=.00180 σ_λ=.00152	σ_u=.00241 σ_λ=.00161	σ_u=.00509 σ_λ=.00122	σ_u=.00311 σ_λ=.00115

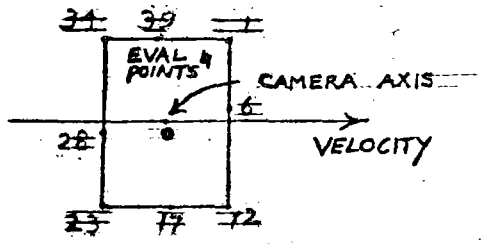
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 32
TOTAL	σ_u=.00715° .217 KM σ_λ=.00399° .121 KM	σ_u=.00865° .262 KM σ_λ=.00671° .204 KM	σ_u=.00471° .143 KM σ_λ=.00536° .162 KM	σ_u=.00685° .208 KM σ_λ=.00699° .206 KM	σ_u=.00889° .269 KM σ_λ=.00523° .159 KM	σ_u=.0118° .358 KM σ_λ=.00759° .230 KM	σ_u=.0100° .303 KM σ_λ=.00726° .220 KM	σ_u=.0134° .405 KM σ_λ=.00785° .238 KM	σ_u=.0109° .330 KM σ_λ=.00521° .158 KM
NAVIGATION	σ_u=.00137 σ_λ=.00150	σ_u=.00140 σ_λ=.00146	σ_u=.00137 σ_λ=.00147	σ_u=.00136 σ_λ=.00147	σ_u=.00136 σ_λ=.00149	σ_u=.00135 σ_λ=.00153	σ_u=.00137 σ_λ=.00154	σ_u=.00141 σ_λ=.00155	σ_u=.00143 σ_λ=.00150
ATTITUDE	σ_u=.00697 σ_λ=.00366	σ_u=.00571 σ_λ=.00526	σ_u=.00431 σ_λ=.00326	σ_u=.00498 σ_λ=.00522	σ_u=.00739 σ_λ=.00466	σ_u=.0136 σ_λ=.00462	σ_u=.00931 σ_λ=.00567	σ_u=.0117 σ_λ=.00426	σ_u=.00882 σ_λ=.00433
CAMERA ON-TIME	σ_u=.00039 σ_λ=.00182	σ_u=.00042 σ_λ=.00180	σ_u=.00039 σ_λ=.00180	σ_u=.00037 σ_λ=.00180	σ_u=.00036 σ_λ=.00182	σ_u=.00035 σ_λ=.00186	σ_u=.00039 σ_λ=.00186	σ_u=.00044 σ_λ=.00187	σ_u=.00043 σ_λ=.00193
MOON RADIUS	σ_u=.00065 σ_λ=.00180	σ_u=.00634 σ_λ=.00346	σ_u=.00127 σ_λ=.00355	σ_u=.00449 σ_λ=.00368	σ_u=.00476 σ_λ=.00339	σ_u=.00509 σ_λ=.00351	σ_u=.0001 σ_λ=.00378	σ_u=.00632 σ_λ=.00618	σ_u=.00631 σ_λ=.00164

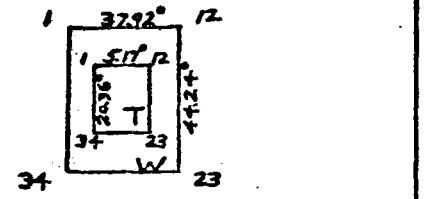
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION I FRAME 164





S/C ALTITUDE = 444 KM
TRUE ANOMALY = 0.0°
INCLINATION = 11.5°
NOTE: APOLLO TCT TA-7
t16



TELEPHOTO LENS, T

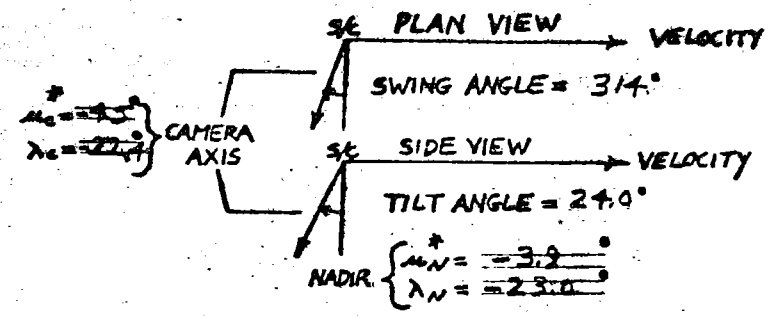
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00461° .140 KM; σ_λ=.00559° .167 KM	σ_u=.00515° .156 KM; σ_λ=.00571° .173 KM	σ_u=.00458° .139 KM; σ_λ=.00536° .162 KM	σ_u=.00543° .165 KM; σ_λ=.00553° .168 KM	σ_u=.00539° .163 KM; σ_λ=.00550° .167 KM	σ_u=.00534° .162 KM; σ_λ=.00555° .168 KM	σ_u=.00465° .141 KM; σ_λ=.00551° .168 KM	σ_u=.00534° .162 KM; σ_λ=.00552° .168 KM	σ_u=.00526° .159 KM; σ_λ=.00557° .169 KM
NAVIGATION	σ_u=.00129 σ_λ=.00457	σ_u=.00129 σ_λ=.00457	σ_u=.00129 σ_λ=.00457	σ_u=.00129 σ_λ=.00457	σ_u=.00129 σ_λ=.00457	σ_u=.00129 σ_λ=.00457	σ_u=.00129 σ_λ=.00457	σ_u=.00130 σ_λ=.00457	σ_u=.00129 σ_λ=.00457
ATTITUDE	σ_u=.00443 σ_λ=.00292	σ_u=.00449 σ_λ=.00297	σ_u=.00439 σ_λ=.00294	σ_u=.00459 σ_λ=.00293	σ_u=.00460 σ_λ=.00292	σ_u=.00462 σ_λ=.00292	σ_u=.00446 σ_λ=.00292	σ_u=.00458 σ_λ=.00294	σ_u=.00454 σ_λ=.00295
CAMERA ON-TIME	σ_u=.00018 σ_λ=.00094	σ_u=.00018 σ_λ=.00094	σ_u=.00018 σ_λ=.00094	σ_u=.00019 σ_λ=.00094	σ_u=.00019 σ_λ=.00094	σ_u=.00019 σ_λ=.00094	σ_u=.00019 σ_λ=.00094	σ_u=.00018 σ_λ=.00094	σ_u=.00018 σ_λ=.00094
MOON RADIUS	σ_u=.00009 σ_λ=.00033	σ_u=.00217 σ_λ=.00142	σ_u=0 σ_λ=.00097	σ_u=.00259 σ_λ=.00044	σ_u=.00248 σ_λ=.00011	σ_u=.00239 σ_λ=.00076	σ_u=.00018 σ_λ=.00031	σ_u=.00241 σ_λ=.00022	σ_u=.00230 σ_λ=.00076

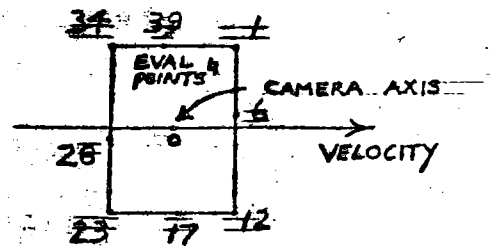
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00540° .164 KM; σ_λ=.00558° .169 KM	σ_u=.00718° .217 KM; σ_λ=.00857° .260 KM	σ_u=.00518° .157 KM; σ_λ=.00701° .213 KM	σ_u=.00918° .279 KM; σ_λ=.00701° .213 KM	σ_u=.00845° .256 KM; σ_λ=.00558° .169 KM	σ_u=.00778° .235 KM; σ_λ=.00791° .240 KM	σ_u=.00571° .173 KM; σ_λ=.00717° .217 KM	σ_u=.00919° .278 KM; σ_λ=.00650° .198 KM	σ_u=.00822° .246 KM; σ_λ=.00571° .174 KM
NAVIGATION	σ_u=.00129 σ_λ=.00457	σ_u=.00128 σ_λ=.00458	σ_u=.00129 σ_λ=.00458	σ_u=.00130 σ_λ=.00459	σ_u=.00129 σ_λ=.00457	σ_u=.00128 σ_λ=.00459	σ_u=.00129 σ_λ=.00459	σ_u=.00132 σ_λ=.00458	σ_u=.00130 σ_λ=.00457
ATTITUDE	σ_u=.00524 σ_λ=.00303	σ_u=.00550 σ_λ=.00382	σ_u=.00499 σ_λ=.00348	σ_u=.00634 σ_λ=.00353	σ_u=.00621 σ_λ=.00304	σ_u=.00620 σ_λ=.00349	σ_u=.00554 σ_λ=.00339	σ_u=.00665 σ_λ=.00328	σ_u=.00608 σ_λ=.00313
CAMERA ON-TIME	σ_u=.00018 σ_λ=.00094	σ_u=.00093 σ_λ=.00096	σ_u=.00019 σ_λ=.00096	σ_u=.00021 σ_λ=.00095	σ_u=.00020 σ_λ=.00094	σ_u=.00019 σ_λ=.00093	σ_u=.00018 σ_λ=.00093	σ_u=.00017 σ_λ=.00093	σ_u=.00017 σ_λ=.00094
MOON RADIUS	σ_u=.00009 σ_λ=.00033	σ_u=.00443 σ_λ=.00607	σ_u=.00056 σ_λ=.00503	σ_u=.00651 σ_λ=.00384	σ_u=.00558 σ_λ=.00038	σ_u=.00452 σ_λ=.00533	σ_u=.00038 σ_λ=.00429	σ_u=.00620 σ_λ=.00310	σ_u=.00538 σ_λ=.00109

* μ = LATITUDE λ = LONGITUDE

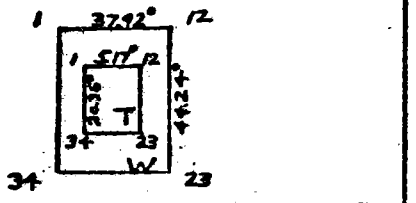
ERROR ANALYSIS RESULTS MISSION I FRAME 173





S/C ALTITUDE = 54.3 KM
TRUE ANOMALY = 12.0°
INCLINATION ≈ 11.5°
NOTE:

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

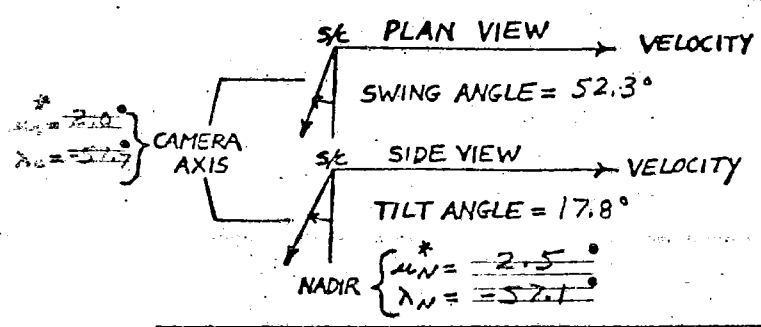
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00632° (.264 KM) σ_λ = .00626° (.190 KM)	σ_u = .00691° (.206 KM) σ_λ = .00709° (.211 KM)	σ_u = .00838° (.253 KM) σ_λ = .00682° (.207 KM)	σ_u = .0117° (.355 KM) σ_λ = .00709° (.215 KM)	σ_u = .0117° (.355 KM) σ_λ = .00652° (.197 KM)	σ_u = .0118° (.358 KM) σ_λ = .00591° (.179 KM)	σ_u = .00911° (.276 KM) σ_λ = .00577° (.175 KM)	σ_u = .00724° (.219 KM) σ_λ = .00529° (.181 KM)	σ_u = .00705° (.214 KM) σ_λ = .00691° (.194 KM)
NAVIGATION	σ_u = .00137 σ_λ = .00229	σ_u = .00133 σ_λ = .00231	σ_u = .00137 σ_λ = .00231	σ_u = .0014 σ_λ = .00231	σ_u = .00143 σ_λ = .00230	σ_u = .00142 σ_λ = .00228	σ_u = .00137 σ_λ = .00228	σ_u = .00133 σ_λ = .00228	σ_u = .00135 σ_λ = .00229
ATTITUDE	σ_u = .00731 σ_λ = .00380	σ_u = .00637 σ_λ = .00410	σ_u = .00634 σ_λ = .00391	σ_u = .00963 σ_λ = .00445	σ_u = .00835 σ_λ = .00434	σ_u = .00810 σ_λ = .00404	σ_u = .00706 σ_λ = .00371	σ_u = .00597 σ_λ = .00392	σ_u = .00664 σ_λ = .00359
CAMERA ON-TIME	σ_u = .00040 σ_λ = .00186	σ_u = .00038 σ_λ = .00186	σ_u = .00040 σ_λ = .00187	σ_u = .00043 σ_λ = .00187	σ_u = .00043 σ_λ = .00185	σ_u = .00043 σ_λ = .00185	σ_u = .00040 σ_λ = .00185	σ_u = .00038 σ_λ = .00185	σ_u = .00038 σ_λ = .00186
MOON RADIUS	σ_u = .00426 σ_λ = .00401	σ_u = .00136 σ_λ = .00479	σ_u = .00440 σ_λ = .00423	σ_u = .00772 σ_λ = .00466	σ_u = .00757 σ_λ = .00391	σ_u = .00776 σ_λ = .00316	σ_u = .00471 σ_λ = .00350	σ_u = .00195 σ_λ = .00346	σ_u = .00180 σ_λ = .00405

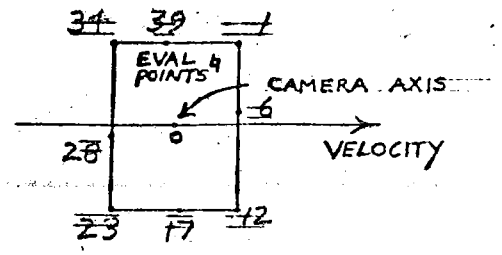
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00991° (.300 KM) σ_λ = .00635° (.192 KM)	σ_u = .00630° (.192 KM) σ_λ = .01247° (.379 KM)	σ_u = .00772° (.234 KM) σ_λ = .01201° (.364 KM)	σ_u = .02186° (.606 KM) σ_λ = .01810° (.500 KM)	σ_u = .0192° (.583 KM) σ_λ = .00844° (.257 KM)	σ_u = .0195° (.559 KM) σ_λ = .01526° (.459 KM)	σ_u = .01120° (.340 KM) σ_λ = .00542° (.147 KM)	σ_u = .00923° (.280 KM) σ_λ = .00556° (.169 KM)	σ_u = .00823° (.249 KM) σ_λ = .00716° (.217 KM)
NAVIGATION	σ_u = .00137 σ_λ = .00229	σ_u = .00128 σ_λ = .00231	σ_u = .00138 σ_λ = .00243	σ_u = .00160 σ_λ = .00243	σ_u = .00132 σ_λ = .00221	σ_u = .00146 σ_λ = .00219	σ_u = .00136 σ_λ = .00221	σ_u = .00127 σ_λ = .00222	σ_u = .00128 σ_λ = .00229
ATTITUDE	σ_u = .00969 σ_λ = .00394	σ_u = .00577 σ_λ = .00743	σ_u = .00585 σ_λ = .00562	σ_u = .0139 σ_λ = .0115	σ_u = .0149 σ_λ = .00537	σ_u = .0134 σ_λ = .00407	σ_u = .0110 σ_λ = .00384	σ_u = .00967 σ_λ = .00477	σ_u = .00805 σ_λ = .00528
CAMERA ON-TIME	σ_u = .00040 σ_λ = .00186	σ_u = .00035 σ_λ = .00182	σ_u = .00041 σ_λ = .00192	σ_u = .00053 σ_λ = .00190	σ_u = .00049 σ_λ = .00187	σ_u = .00044 σ_λ = .00181	σ_u = .00040 σ_λ = .00182	σ_u = .00036 σ_λ = .00182	σ_u = .00056 σ_λ = .00185
MOON RADIUS	σ_u = .00450 σ_λ = .00401	σ_u = .00098 σ_λ = .00364	σ_u = .00481 σ_λ = .01011	σ_u = .0144 σ_λ = .0111	σ_u = .0124 σ_λ = .00421	σ_u = .0104 σ_λ = .00173	σ_u = .00439 σ_λ = .00287	σ_u = .00114 σ_λ = .00008	σ_u = .00167 σ_λ = .00383

* μ = LATITUDE λ = LONGITUDE

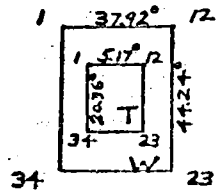
ERROR ANALYSIS RESULTS MISSION I FRAME 174





S/C ALTITUDE = 70.1 KM
TRUE ANOMALY = 341 °
INCLINATION ≈ 11.5 °
NOTE:

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

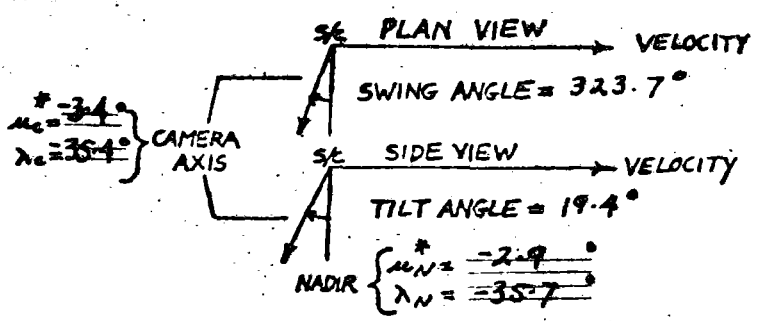
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00853°, .289 KM; σ_λ = .00915°, .277 KM	σ_u = .00852°, .257 KM; σ_λ = .00897°, .272 KM	σ_u = .00893°, .271 KM; σ_λ = .00882°, .267 KM	σ_u = .0109°, .329 KM; σ_λ = .00903°, .275 KM	σ_u = .0114°, .346 KM; σ_λ = .00851°, .259 KM	σ_u = .0120°, .364 KM; σ_λ = .00975°, .296 KM	σ_u = .0122°, .369 KM; σ_λ = .00957°, .290 KM	σ_u = .00951°, .292 KM; σ_λ = .00966°, .292 KM	σ_u = .00881°, .268 KM; σ_λ = .00929°, .281 KM
NAVIGATION	σ_u = .00279; σ_λ = .00685	σ_u = .00279; σ_λ = .00685	σ_u = .00279; σ_λ = .00682	σ_u = .00279; σ_λ = .00693	σ_u = .00269; σ_λ = .00685	σ_u = .00269; σ_λ = .00697	σ_u = .00272; σ_λ = .00697	σ_u = .00279; σ_λ = .00699	σ_u = .00285; σ_λ = .00680
ATTITUDE	σ_u = .00976; σ_λ = .00452	σ_u = .00785; σ_λ = .00476	σ_u = .00815; σ_λ = .00442	σ_u = .00967; σ_λ = .00487	σ_u = .00964; σ_λ = .00492	σ_u = .0103; σ_λ = .00531	σ_u = .00946; σ_λ = .00495	σ_u = .00884; σ_λ = .00538	σ_u = .00839; σ_λ = .00493
CAMERA ON-TIME	σ_u = .00034; σ_λ = .00184	σ_u = .00037; σ_λ = .00183	σ_u = .00034; σ_λ = .00183	σ_u = .00031; σ_λ = .00184	σ_u = .00131; σ_λ = .00164	σ_u = .00031; σ_λ = .00195	σ_u = .00034; σ_λ = .00183	σ_u = .00037; σ_λ = .00185	σ_u = .00037; σ_λ = .00184
MOON RADIUS	σ_u = .00261; σ_λ = .00355	σ_u = .00113; σ_λ = .00279	σ_u = .00237; σ_λ = .00287	σ_u = .00532; σ_λ = .00899	σ_u = .00536; σ_λ = .00362	σ_u = .00534; σ_λ = .00440	σ_u = .00503; σ_λ = .00424	σ_u = .00504; σ_λ = .00439	σ_u = .00507; σ_λ = .00359

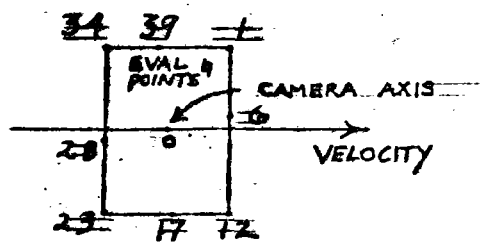
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT
TOTAL	σ_u = .0111°, .336 KM; σ_λ = .00972°, .277 KM	σ_u = .00781°, .213 KM; σ_λ = .00960°, .291 KM	σ_u = .00669°, .202 KM; σ_λ = .00832°, .252 KM	σ_u = .0121°, .366 KM; σ_λ = .0105°, .318 KM	σ_u = .0145°, .439 KM; σ_λ = .0104°, .321 KM	σ_u = .0242°, .733 KM; σ_λ = .0149°, .449 KM	σ_u = .0128°, .389 KM; σ_λ = .0137°, .415 KM	σ_u = .0138°, .419 KM; σ_λ = .0138°, .421 KM	σ_u = .0112°, .339 KM; σ_λ = .[illegible]°, [illegible] KM
NAVIGATION	σ_u = .00293; σ_λ = .00685	σ_u = .00283; σ_λ = .00693	σ_u = .00276; σ_λ = .00722	σ_u = .00271; σ_λ = .00723	σ_u = .00265; σ_λ = .00683	σ_u = .00305; σ_λ = .00[illegible]	σ_u = .00[illegible]; σ_λ = .00699	σ_u = .00[illegible]; σ_λ = .00709	σ_u = .00285; σ_λ = .00[illegible]
ATTITUDE	σ_u = .0104; σ_λ = .00470	σ_u = .00590; σ_λ = .00551	σ_u = .00576; σ_λ = .00440	σ_u = .00610; σ_λ = .00781	σ_u = .0125; σ_λ = .00713	σ_u = .0218; σ_λ = .00765	σ_u = .[illegible]; σ_λ = .00679	σ_u = .0140; σ_λ = .00916	σ_u = .0134; σ_λ = .00679
CAMERA ON-TIME	σ_u = .00034; σ_λ = .00184	σ_u = .00040; σ_λ = .00179	σ_u = .00035; σ_λ = .00179	σ_u = .00029; σ_λ = .00179	σ_u = .00176; σ_λ = .00154	σ_u = .00023; σ_λ = .00195	σ_u = .00[illegible]; σ_λ = .00177	σ_u = .00042; σ_λ = .00193	σ_u = .00044; σ_λ = .00195
MOON RADIUS	σ_u = .00261; σ_λ = .00355	σ_u = .00249; σ_λ = .00106	σ_u = .00213; σ_λ = .00114	σ_u = .00861; σ_λ = .00126	σ_u = .00917; σ_λ = .00[illegible]	σ_u = .0101; σ_λ = .0[illegible]	σ_u = .00[illegible]; σ_λ = .00935	σ_u = .00342; σ_λ = .00853	σ_u = .00295; σ_λ = .00371

* μ = LATITUDE λ = LONGITUDE

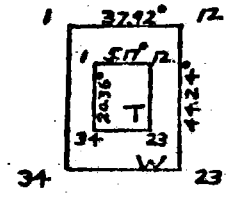
ERROR ANALYSIS RESULTS MISSION I FRAME 175





S/C ALTITUDE = 48.5 KM
TRUE ANOMALY = 6.6°
INCLINATION ≈ -11.5°
NOTE: APOLLO TGT

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

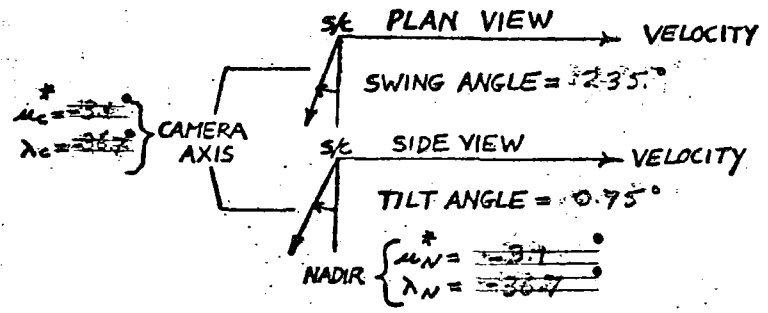
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00789° .269 KM σ_λ=.00495° .150 KM	σ_u=.00625° .190 KM σ_λ=.00554° .168 KM	σ_u=.00754° .229 KM σ_λ=.00537° .163 KM	σ_u=.01036° .325 KM σ_λ=.00556° .169 KM	σ_u=.01046° .318 KM σ_λ=.00514° .153 KM	σ_u=.01059° .320 KM σ_λ=.00473° .143 KM	σ_u=.00824° .250 KM σ_λ=.00462° .140 KM	σ_u=.00660° .202 KM σ_λ=.00483° .146 KM	σ_u=.00647° .196 KM σ_λ=.00512° .155 KM
NAVIGATION	σ_u=.00255 σ_λ=.00223	σ_u=.00252 σ_λ=.00223	σ_u=.00255 σ_λ=.00223	σ_u=.00259 σ_λ=.00224	σ_u=.00259 σ_λ=.00223	σ_u=.00259 σ_λ=.00222	σ_u=.00255 σ_λ=.00222	σ_u=.00252 σ_λ=.00222	σ_u=.00252 σ_λ=.00222
ATTITUDE	σ_u=.00626 σ_λ=.00314	σ_u=.00549 σ_λ=.00340	σ_u=.00582 σ_λ=.00320	σ_u=.00716 σ_λ=.00359	σ_u=.00741 σ_λ=.00347	σ_u=.00769 σ_λ=.00335	σ_u=.00659 σ_λ=.00310	σ_u=.00598 σ_λ=.00331	σ_u=.00576 σ_λ=.00334
CAMERA ON-TIME	σ_u=.00039 σ_λ=.00184	σ_u=.00038 σ_λ=.00184	σ_u=.00039 σ_λ=.00184	σ_u=.00041 σ_λ=.00184	σ_u=.00041 σ_λ=.00184	σ_u=.00041 σ_λ=.00183	σ_u=.00039 σ_λ=.00183	σ_u=.00038 σ_λ=.00183	σ_u=.00038 σ_λ=.00184
MOON RADIUS	σ_u=.00405 σ_λ=.00252	σ_u=.00155 σ_λ=.00327	σ_u=.00388 σ_λ=.00319	σ_u=.00701 σ_λ=.00309	σ_u=.00691 σ_λ=.00245	σ_u=.00679 σ_λ=.00169	σ_u=.00422 σ_λ=.00185	σ_u=.00146 σ_λ=.00202	σ_u=.00150 σ_λ=.00258

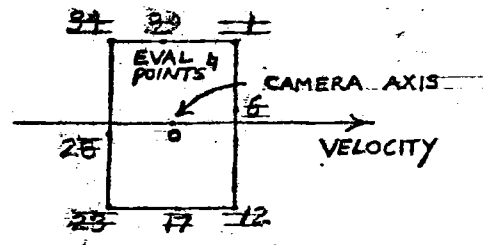
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00885° .268 KM σ_λ=.00503° .152 KM	σ_u=.00504° .152 KM σ_λ=.01005° .305 KM	σ_u=.00780° .236 KM σ_λ=.00949° .288 KM	σ_u=.01617° .491 KM σ_λ=.01238° .375 KM	σ_u=.01658° .503 KM σ_λ=.00601° .182 KM	σ_u=.01756° .533 KM σ_λ=.00555° .168 KM	σ_u=.01094° .330 KM σ_λ=.00496° .151 KM	σ_u=.00917° .275 KM σ_λ=.00533° .162 KM	σ_u=.00758° .230 KM σ_λ=.00585° .177 KM
NAVIGATION	σ_u=.00255 σ_λ=.00223	σ_u=.00249 σ_λ=.00228	σ_u=.00256 σ_λ=.00230	σ_u=.00271 σ_λ=.00234	σ_u=.00266 σ_λ=.00224	σ_u=.00262 σ_λ=.00216	σ_u=.00254 σ_λ=.00218	σ_u=.00250 σ_λ=.00219	σ_u=.00250 σ_λ=.00222
ATTITUDE	σ_u=.00743 σ_λ=.00326	σ_u=.00480 σ_λ=.00581	σ_u=.00478 σ_λ=.00424	σ_u=.00990 σ_λ=.00842	σ_u=.01197 σ_λ=.00528	σ_u=.01424 σ_λ=.00364	σ_u=.00984 σ_λ=.00341	σ_u=.00869 σ_λ=.00427	σ_u=.00701 σ_λ=.00450
CAMERA ON-TIME	σ_u=.00039 σ_λ=.00184	σ_u=.00036 σ_λ=.00187	σ_u=.00040 σ_λ=.00189	σ_u=.00046 σ_λ=.00189	σ_u=.00043 σ_λ=.00184	σ_u=.00041 σ_λ=.00181	σ_u=.00039 σ_λ=.00182	σ_u=.00037 σ_λ=.00182	σ_u=.00037 σ_λ=.00184
MOON RADIUS	σ_u=.00405 σ_λ=.00252	σ_u=.00125 σ_λ=.00765	σ_u=.00409 σ_λ=.00795	σ_u=.01249 σ_λ=.00856	σ_u=.01116 σ_λ=.00271	σ_u=.00994 σ_λ=.00309	σ_u=.00401 σ_λ=.00223	σ_u=.00150 σ_λ=.00144	σ_u=.00139 σ_λ=.00239

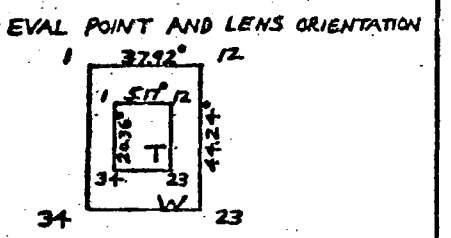
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION I FRAME 179





S/C ALTITUDE = 496 KM
TRUE ANOMALY = 7.4 °
INCLINATION = 11.5 °
NOTE: APOLLO TGT TA-81 +8



TELEPHOTO LENS, T

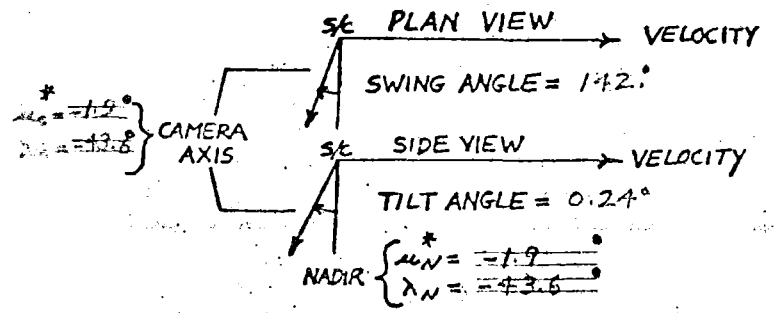
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\sqrt{u}$=.00493° .149 KM $\sqrt{\lambda}$=.00532° .162KM	$\sqrt{u}$=.00550° .166 KM $\sqrt{\lambda}$=.00552° .167 KM	$\sqrt{u}$=.00487° .148 KM $\sqrt{\lambda}$=.00541° .164KM	$\sqrt{u}$=.00560° .170 KM $\sqrt{\lambda}$=.00536° .162 KM	$\sqrt{u}$=.00560° .170 KM $\sqrt{\lambda}$=.00533° .162 KM	$\sqrt{u}$=.00559° .169 KM $\sqrt{\lambda}$=.00539° .163 KM	$\sqrt{u}$=.00499° .151 KM $\sqrt{\lambda}$=.00533° .162 KM	$\sqrt{u}$=.00574° .174 KM $\sqrt{\lambda}$=.00532° .162 KM	$\sqrt{u}$=.00563° .171 KM $\sqrt{\lambda}$=.00537° .162 KM
NAVIGATION	$\sqrt{u}$=.00138 $\sqrt{\lambda}$=.00426	$\sqrt{u}$=.00145 $\sqrt{\lambda}$=.00428	$\sqrt{u}$=.00139 $\sqrt{\lambda}$=.00428	$\sqrt{u}$=.00132 $\sqrt{\lambda}$=.00429	$\sqrt{u}$=.00133 $\sqrt{\lambda}$=.00427	$\sqrt{u}$=.00134 $\sqrt{\lambda}$=.00425	$\sqrt{u}$=.00138 $\sqrt{\lambda}$=.00424	$\sqrt{u}$=.00143 $\sqrt{\lambda}$=.00425	$\sqrt{u}$=.00144 $\sqrt{\lambda}$=.00426
ATTITUDE	$\sqrt{u}$=.00473 $\sqrt{\lambda}$=.00295	$\sqrt{u}$=.00476 $\sqrt{\lambda}$=.00302	$\sqrt{u}$=.00466 $\sqrt{\lambda}$=.00296	$\sqrt{u}$=.00487 $\sqrt{\lambda}$=.00295	$\sqrt{u}$=.00491 $\sqrt{\lambda}$=.00294	$\sqrt{u}$=.00496 $\sqrt{\lambda}$=.00295	$\sqrt{u}$=.00279 $\sqrt{\lambda}$=.00295	$\sqrt{u}$=.00492 $\sqrt{\lambda}$=.00299	$\sqrt{u}$=.00485 $\sqrt{\lambda}$=.00300
CAMERA ON-TIME	$\sqrt{u}$=.00025 $\sqrt{\lambda}$=.00121	$\sqrt{u}$=.00024 $\sqrt{\lambda}$=.00122	$\sqrt{u}$=.00025 $\sqrt{\lambda}$=.00122	$\sqrt{u}$=.00025 $\sqrt{\lambda}$=.00121	$\sqrt{u}$=.00025 $\sqrt{\lambda}$=.00121	$\sqrt{u}$=.00025 $\sqrt{\lambda}$=.00121	$\sqrt{u}$=.00025 $\sqrt{\lambda}$=.00121	$\sqrt{u}$=.00024 $\sqrt{\lambda}$=.00121	$\sqrt{u}$=.00024 $\sqrt{\lambda}$=.00122
MOON RADIUS	$\sqrt{u}$=.00007 $\sqrt{\lambda}$=.00016	$\sqrt{u}$=.00233 $\sqrt{\lambda}$=.00124	$\sqrt{u}$=.00016 $\sqrt{\lambda}$=.00080	$\sqrt{u}$=.00243 $\sqrt{\lambda}$=.00028	$\sqrt{u}$=.00231 $\sqrt{\lambda}$=.00026	$\sqrt{u}$=.00218 $\sqrt{\lambda}$=.00091	$\sqrt{u}$=.00002 $\sqrt{\lambda}$=.00098	$\sqrt{u}$=.00257 $\sqrt{\lambda}$=.00004	$\sqrt{u}$=.00296 $\sqrt{\lambda}$=.00059

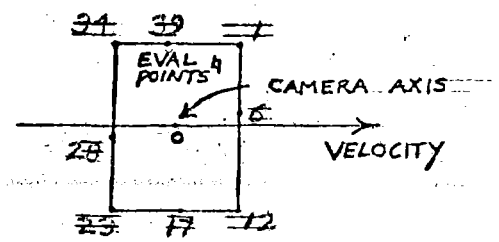
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\sqrt{u}$=.00577° .174 KM $\sqrt{\lambda}$=.00538° .163 KM	$\sqrt{u}$=.00747° .226 KM $\sqrt{\lambda}$=.00863° .262 KM	$\sqrt{u}$=.00525° .159 KM $\sqrt{\lambda}$=.00769° .233 KM	$\sqrt{u}$=.00906° .275 KM $\sqrt{\lambda}$=.00709° .215 KM	$\sqrt{u}$=.00862° .262 KM $\sqrt{\lambda}$=.00545° .167 KM	$\sqrt{u}$=.00833° .247 KM $\sqrt{\lambda}$=.00792° .240 KM	$\sqrt{u}$=.00636° .193 KM $\sqrt{\lambda}$=.00717° .217 KM	$\sqrt{u}$=.00986° .299 KM $\sqrt{\lambda}$=.00647° .196 KM	$\sqrt{u}$=.00870° .264 KM $\sqrt{\lambda}$=.00555° .178 KM
NAVIGATION	$\sqrt{u}$=.00138 $\sqrt{\lambda}$=.00426	$\sqrt{u}$=.00176 $\sqrt{\lambda}$=.00475	$\sqrt{u}$=.00139 $\sqrt{\lambda}$=.00470	$\sqrt{u}$=.00102 $\sqrt{\lambda}$=.00470	$\sqrt{u}$=.00126 $\sqrt{\lambda}$=.00430	$\sqrt{u}$=.00143 $\sqrt{\lambda}$=.00435	$\sqrt{u}$=.00135 $\sqrt{\lambda}$=.00428	$\sqrt{u}$=.00129 $\sqrt{\lambda}$=.00423	$\sqrt{u}$=.00151 $\sqrt{\lambda}$=.00423
ATTITUDE	$\sqrt{u}$=.00559 $\sqrt{\lambda}$=.00306	$\sqrt{u}$=.00560 $\sqrt{\lambda}$=.00398	$\sqrt{u}$=.00504 $\sqrt{\lambda}$=.00348	$\sqrt{u}$=.00645 $\sqrt{\lambda}$=.00362	$\sqrt{u}$=.00660 $\sqrt{\lambda}$=.00308	$\sqrt{u}$=.00692 $\sqrt{\lambda}$=.00351	$\sqrt{u}$=.00619 $\sqrt{\lambda}$=.00341	$\sqrt{u}$=.00738 $\sqrt{\lambda}$=.00339	$\sqrt{u}$=.00651 $\sqrt{\lambda}$=.00328
CAMERA ON-TIME	$\sqrt{u}$=.00025 $\sqrt{\lambda}$=.00121	$\sqrt{u}$=.00023 $\sqrt{\lambda}$=.00124	$\sqrt{u}$=.00025 $\sqrt{\lambda}$=.00123	$\sqrt{u}$=.00027 $\sqrt{\lambda}$=.00123	$\sqrt{u}$=.00026 $\sqrt{\lambda}$=.00121	$\sqrt{u}$=.00026 $\sqrt{\lambda}$=.00120	$\sqrt{u}$=.00246 $\sqrt{\lambda}$=.00120	$\sqrt{u}$=.00023 $\sqrt{\lambda}$=.00121	$\sqrt{u}$=.00023 $\sqrt{\lambda}$=.00122
MOON RADIUS	$\sqrt{u}$=.00007 $\sqrt{\lambda}$=.00016	$\sqrt{u}$=.00461 $\sqrt{\lambda}$=.00588	$\sqrt{u}$=.00038 $\sqrt{\lambda}$=.00484	$\sqrt{u}$=.00627 $\sqrt{\lambda}$=.00367	$\sqrt{u}$=.00540 $\sqrt{\lambda}$=.00052	$\sqrt{u}$=.00439 $\sqrt{\lambda}$=.00548	$\sqrt{u}$=.00052 $\sqrt{\lambda}$=.00448	$\sqrt{u}$=.00641 $\sqrt{\lambda}$=.00333	$\sqrt{u}$=.00557 $\sqrt{\lambda}$=.00085

* u = LATITUDE λ = LONGITUDE

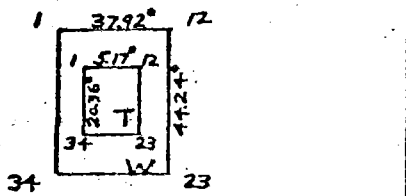
ERROR ANALYSIS RESULTS MISSION I FRAME 191





S/C ALTITUDE = [illegible] KM
TRUE ANOMALY = 213 °
INCLINATION ≈ [illegible] °
NOTE: APOLLO TOT TA = 9.21 ±16

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

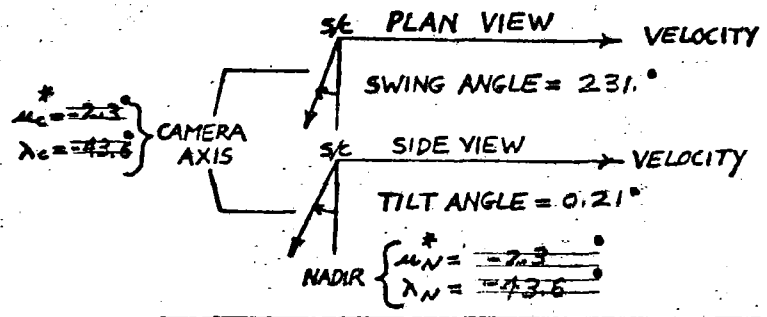
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00599° ·182 KM σ_λ=.00649° ·196 KM	σ_u=.00634° ·192 KM σ_λ=.00634° ·192 KM	σ_u=.00586° ·178 KM σ_λ=.00612° ·186 KM	σ_u=.00658° ·199 KM σ_λ=.00648° ·196 KM	σ_u=.00663° ·202 KM σ_λ=.00650° ·197 KM	σ_u=.00670° ·203 KM σ_λ=.00659° ·199 KM	σ_u=.00612° ·186 KM σ_λ=.00653° ·198 KM	σ_u=.00669° ·203 KM σ_λ=.00656° ·199 KM	σ_u=.00653° ·198 KM σ_λ=.00656° ·199 KM
NAVIGATION	σ_u=.00314 σ_λ=.00580	σ_u=.00316 σ_λ=.00579	σ_u=.00314 σ_λ=.00580	σ_u=.00313 σ_λ=.00580	σ_u=.00313 σ_λ=.00581	σ_u=.00313 σ_λ=.00581	σ_u=.00314 σ_λ=.00581	σ_u=.00316 σ_λ=.00580	σ_u=.00316 σ_λ=.00580
ATTITUDE	σ_u=.00510 σ_λ=.00274	σ_u=.00499 σ_λ=.00291	σ_u=.00494 σ_λ=.00275	σ_u=.00525 σ_λ=.00273	σ_u=.00536 σ_λ=.00273	σ_u=.00550 σ_λ=.00273	σ_u=.00525 σ_λ=.00275	σ_u=.00531 σ_λ=.00290	σ_u=.00517 σ_λ=.00299
CAMERA ON-TIME	σ_u=.00020 σ_λ=.00094	σ_u=.00020 σ_λ=.00094	σ_u=.00020 σ_λ=.00094	σ_u=.00020 σ_λ=.00094	σ_u=.00020 σ_λ=.00094	σ_u=.00020 σ_λ=.00094	σ_u=.00020 σ_λ=.00094	σ_u=.00020 σ_λ=.00094	σ_u=.00020 σ_λ=.00094
MOON RADIUS	σ_u=.00005 σ_λ=.00002	σ_u=.00230 σ_λ=.00107	σ_u=.00014 σ_λ=.00062	σ_u=.00244 σ_λ=.00008	σ_u=.00233 σ_λ=.00097	σ_u=.00219 σ_λ=.00112	σ_u=.00004 σ_λ=.00066	σ_u=.00255 σ_λ=.00013	σ_u=.00243 σ_λ=.00092

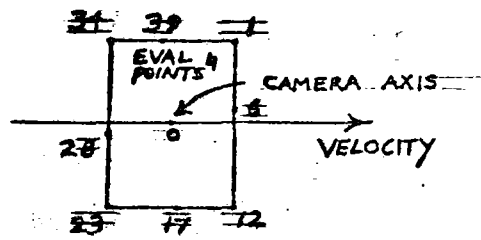
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00682° ·207 KM σ_λ=.00653° ·199 KM	σ_u=.00755° ·229 KM σ_λ=.00918° ·278 KM	σ_u=.00970° ·295 KM σ_λ=.00811° ·245 KM	σ_u=.00952° ·289 KM σ_λ=.00777° ·235 KM	σ_u=.00958° ·290 KM σ_λ=.00666° ·202 KM	σ_u=.00998° ·303 KM σ_λ=.00887° ·269 KM	σ_u=.00807° ·245 KM σ_λ=.00821° ·250 KM	σ_u=.01111° ·338 KM σ_λ=.00771° ·234 KM	σ_u=.00910° ·278 KM σ_λ=[illegible]
NAVIGATION	σ_u=.00314 σ_λ=.00580	σ_u=.00316 σ_λ=.00577	σ_u=.00314 σ_λ=.00579	σ_u=.00313 σ_λ=.00580	σ_u=.00311 σ_λ=.00581	σ_u=.00310 σ_λ=.00587	σ_u=.00315 σ_λ=.00586	σ_u=.00329 σ_λ=.00585	σ_u=.00320 σ_λ=.00580
ATTITUDE	σ_u=.00605 σ_λ=.00285	σ_u=.00517 σ_λ=.00423	σ_u=.00474 σ_λ=.00319	σ_u=.00643 σ_λ=.00377	σ_u=.00726 σ_λ=.00302	σ_u=.00840 σ_λ=.00326	σ_u=.00741 σ_λ=.00328	σ_u=.00847 σ_λ=.00350	σ_u=.00691 σ_λ=.00358
CAMERA ON-TIME	σ_u=.00020 σ_λ=.00094	σ_u=.00019 σ_λ=.00094	σ_u=.00020 σ_λ=.00094	σ_u=.00021 σ_λ=.00094	σ_u=.00020 σ_λ=.00094	σ_u=.00020 σ_λ=.00094	σ_u=.00019 σ_λ=.00094	σ_u=.00020 σ_λ=.00094	σ_u=.00019 σ_λ=.00094
MOON RADIUS	σ_u=.00005 σ_λ=.00002	σ_u=.00452 σ_λ=.00567	σ_u=.00093 σ_λ=.00462	σ_u=.00628 σ_λ=.00341	σ_u=.00541 σ_λ=.00075	σ_u=.00439 σ_λ=.00572	σ_u=.00054 σ_λ=.00467	σ_u=.00642 σ_λ=.00347	σ_u=.00553 σ_λ=.00070

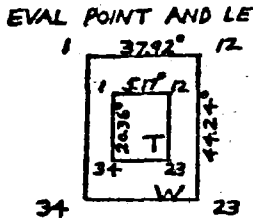
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION I FRAME 207





S/C ALTITUDE = 117.6 KM
TRUE ANOMALY = 4.1 °
INCLINATION = 117.5 °
NOTE: APOLLO TGT. IA = 9.28



TELEPHOTO LENS, T

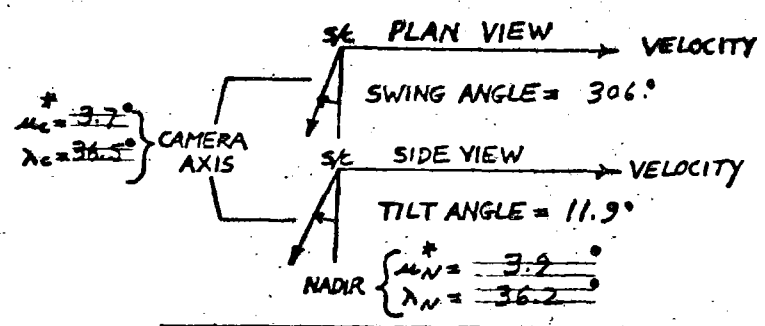
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\sqrt{u}$=.00613 .186 KM $\sqrt{\lambda}$=.00812 .246 KM	$\sqrt{u}$=.00648 .196 KM $\sqrt{\lambda}$=.00826 .250 KM	$\sqrt{u}$=.00603 .183 KM $\sqrt{\lambda}$=.00816 .247 KM	$\sqrt{u}$=.00675 .205 KM $\sqrt{\lambda}$=.00812 .246 KM	$\sqrt{u}$=.00678 .205 KM $\sqrt{\lambda}$=.00812 .246 KM	$\sqrt{u}$=.00683 .207 KM $\sqrt{\lambda}$=.00817 .247 KM	$\sqrt{u}$=.00624 .189 KM $\sqrt{\lambda}$=.00813 .246 KM	$\sqrt{u}$=.00678 .208 KM $\sqrt{\lambda}$=.00816 .247 KM	$\sqrt{u}$=.00664 .202 KM $\sqrt{\lambda}$=.00818 .248 KM
NAVIGATION	$\sqrt{u}$=.00345 $\sqrt{\lambda}$=.00756	$\sqrt{u}$=.00342 $\sqrt{\lambda}$=.00757	$\sqrt{u}$=.00345 $\sqrt{\lambda}$=.00756	$\sqrt{u}$=.00348 $\sqrt{\lambda}$=.00756	$\sqrt{u}$=.00348 $\sqrt{\lambda}$=.00355	$\sqrt{u}$=.00348 $\sqrt{\lambda}$=.00754	$\sqrt{u}$=.00345 $\sqrt{\lambda}$=.00755	$\sqrt{u}$=.00342 $\sqrt{\lambda}$=.00755	$\sqrt{u}$=.00342 $\sqrt{\lambda}$=.00756
ATTITUDE	$\sqrt{u}$=.00507 $\sqrt{\lambda}$=.00282	$\sqrt{u}$=.00500 $\sqrt{\lambda}$=.00295	$\sqrt{u}$=.00494 $\sqrt{\lambda}$=.00283	$\sqrt{u}$=.00522 $\sqrt{\lambda}$=.00281	$\sqrt{u}$=.00532 $\sqrt{\lambda}$=.00280	$\sqrt{u}$=.00543 $\sqrt{\lambda}$=.00281	$\sqrt{u}$=.00520 $\sqrt{\lambda}$=.00282	$\sqrt{u}$=.00528 $\sqrt{\lambda}$=.00293	$\sqrt{u}$=.00515 $\sqrt{\lambda}$=.00294
CAMERA ON-TIME	$\sqrt{u}$=.00020 $\sqrt{\lambda}$=.00094	$\sqrt{u}$=.00020 $\sqrt{\lambda}$=.00094	$\sqrt{u}$=.00020 $\sqrt{\lambda}$=.00094	$\sqrt{u}$=.00020 $\sqrt{\lambda}$=.00094	$\sqrt{u}$=.00020 $\sqrt{\lambda}$=.00094	$\sqrt{u}$=.00020 $\sqrt{\lambda}$=.00093	$\sqrt{u}$=.00020 $\sqrt{\lambda}$=.00094	$\sqrt{u}$=.00019 $\sqrt{\lambda}$=.00094	$\sqrt{u}$=.00019 $\sqrt{\lambda}$=.00094
MOON RADIUS	$\sqrt{u}$=.00002 $\sqrt{\lambda}$=.00005	$\sqrt{u}$=.00227 $\sqrt{\lambda}$=.00113	$\sqrt{u}$=.00011 $\sqrt{\lambda}$=.00069	$\sqrt{u}$=.00247 $\sqrt{\lambda}$=.00015	$\sqrt{u}$=.00236 $\sqrt{\lambda}$=.00039	$\sqrt{u}$=.00222 $\sqrt{\lambda}$=.00104	$\sqrt{u}$=.00007 $\sqrt{\lambda}$=.00060	$\sqrt{u}$=.00252 $\sqrt{\lambda}$=.00006	$\sqrt{u}$=.00241 $\sqrt{\lambda}$=.00098

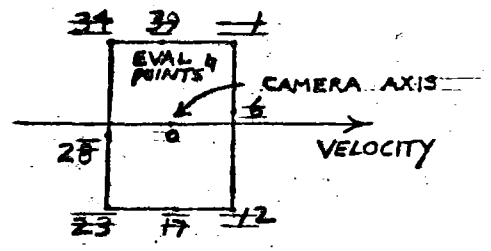
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\sqrt{u}$=.00693 .211 KM $\sqrt{\lambda}$=.00816 .247 KM	$\sqrt{u}$=.00778 .235 KM $\sqrt{\lambda}$=.01049 .319 KM	$\sqrt{u}$=.00603 .183 KM $\sqrt{\lambda}$=.00961 .292 KM	$\sqrt{u}$=.00979 .296 KM $\sqrt{\lambda}$=.00924 .280 KM	$\sqrt{u}$=.00969 .294 KM $\sqrt{\lambda}$=.00822 .250 KM	$\sqrt{u}$=.00988 .300 KM $\sqrt{\lambda}$=.01001 .304 KM	$\sqrt{u}$=.00797 .242 KM $\sqrt{\lambda}$=.00945 .286 KM	$\sqrt{u}$=.01098 .335 KM $\sqrt{\lambda}$=.00900 .273 KM	$\sqrt{u}$=.00945 .286 KM $\sqrt{\lambda}$=.00941 .285 KM
NAVIGATION	$\sqrt{u}$=.00345 $\sqrt{\lambda}$=.00756	$\sqrt{u}$=.00337 $\sqrt{\lambda}$=.00765	$\sqrt{u}$=.00345 $\sqrt{\lambda}$=.00764	$\sqrt{u}$=.00357 $\sqrt{\lambda}$=.00763	$\sqrt{u}$=.00353 $\sqrt{\lambda}$=.00755	$\sqrt{u}$=.00349 $\sqrt{\lambda}$=.00750	$\sqrt{u}$=.00345 $\sqrt{\lambda}$=.00752	$\sqrt{u}$=.00342 $\sqrt{\lambda}$=.00753	$\sqrt{u}$=.00339 $\sqrt{\lambda}$=.00756
ATTITUDE	$\sqrt{u}$=.00601 $\sqrt{\lambda}$=.00293	$\sqrt{u}$=.00538 $\sqrt{\lambda}$=.00418	$\sqrt{u}$=.00491 $\sqrt{\lambda}$=.00329	$\sqrt{u}$=.00656 $\sqrt{\lambda}$=.00373	$\sqrt{u}$=.00720 $\sqrt{\lambda}$=.00303	$\sqrt{u}$=.00810 $\sqrt{\lambda}$=.00335	$\sqrt{u}$=.00716 $\sqrt{\lambda}$=.00329	$\sqrt{u}$=.00826 $\sqrt{\lambda}$=.00345	$\sqrt{u}$=.00689 $\sqrt{\lambda}$=.00349
CAMERA ON-TIME	$\sqrt{u}$=.00020 $\sqrt{\lambda}$=.00094	$\sqrt{u}$=.00019 $\sqrt{\lambda}$=.00095	$\sqrt{u}$=.00020 $\sqrt{\lambda}$=.00095	$\sqrt{u}$=.00021 $\sqrt{\lambda}$=.00094	$\sqrt{u}$=.00020 $\sqrt{\lambda}$=.00094	$\sqrt{u}$=.00020 $\sqrt{\lambda}$=.00093	$\sqrt{u}$=.00020 $\sqrt{\lambda}$=.00093	$\sqrt{u}$=.00019 $\sqrt{\lambda}$=.00093	$\sqrt{u}$=.00019 $\sqrt{\lambda}$=.00094
MOON RADIUS	$\sqrt{u}$=.00002 $\sqrt{\lambda}$=.00005	$\sqrt{u}$=.00449 $\sqrt{\lambda}$=.00575	$\sqrt{u}$=.00645 $\sqrt{\lambda}$=.00470	$\sqrt{u}$=.00633 $\sqrt{\lambda}$=.00350	$\sqrt{u}$=.00544 $\sqrt{\lambda}$=.00067	$\sqrt{u}$=.00442 $\sqrt{\lambda}$=.00564	$\sqrt{u}$=.00050 $\sqrt{\lambda}$=.00460	$\sqrt{u}$=.00637 $\sqrt{\lambda}$=.00390	$\sqrt{u}$=.00530 $\sqrt{\lambda}$=.00076

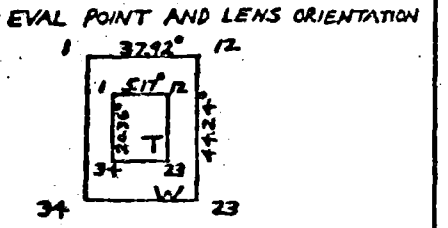
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION II FRAME 26





s/c ALTITUDE = 16.5 KM
TRUE ANOMALY = 356.°
INCLINATION = 12.1°
NOTE:



TELEPHOTO LENS, T

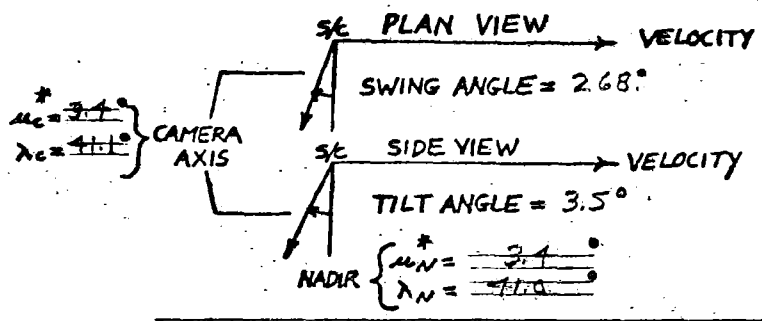
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00692° .210 KM σ_λ=.00439° .133 KM	σ_u=.00604° .183 KM σ_λ=.00551° .368 KM	σ_u=.00656° .199 KM σ_λ=.00476° .144 KM	σ_u=.00837° .254 KM σ_λ=.00487° .148 KM	σ_u=.00856° .260 KM σ_λ=.00455° .138 KM	σ_u=.00881° .267 KM σ_λ=.00426° .129 KM	σ_u=.00731° .222 KM σ_λ=.00411° .124 KM	σ_u=.00668° .202 KM σ_λ=.00494° .150 KM	σ_u=.00637° .193 KM σ_λ=.00516° .156 KM
NAVIGATION	σ_u=.00473 σ_λ=.00211	σ_u=.00473 σ_λ=.00211	σ_u=.00473 σ_λ=.00211	σ_u=.00474 σ_λ=.00211	σ_u=.00474 σ_λ=.00211	σ_u=.00474 σ_λ=.00212	σ_u=.00473 σ_λ=.00212	σ_u=.00473 σ_λ=.00212	σ_u=.00473 σ_λ=.00212
ATTITUDE	σ_u=.00460 σ_λ=.00293	σ_u=.00373 σ_λ=.00382	σ_u=.00408 σ_λ=.00299	σ_u=.00501 σ_λ=.00350	σ_u=.00543 σ_λ=.00337	σ_u=.00594 σ_λ=.00324	σ_u=.00512 σ_λ=.00289	σ_u=.00465 σ_λ=.00380	σ_u=.00423 σ_λ=.00380
CAMERA ON-TIME	σ_u=.00030 σ_λ=.00155	σ_u=.00031 σ_λ=.00155	σ_u=.00030 σ_λ=.00155	σ_u=.00030 σ_λ=.00155	σ_u=.00030 σ_λ=.00155	σ_u=.00030 σ_λ=.00155	σ_u=.00030 σ_λ=.00155	σ_u=.00031 σ_λ=.00155	σ_u=.00031 σ_λ=.00155
MOON RADIUS	σ_u=.00206 σ_λ=.00195	σ_u=.00024 σ_λ=.00298	σ_u=.00196 σ_λ=.00260	σ_u=.00473 σ_λ=.00215	σ_u=.00460 σ_λ=.00157	σ_u=.00444 σ_λ=.00089	σ_u=.00216 σ_λ=.00129	σ_u=.00094 σ_λ=.00176	σ_u=.00035 σ_λ=.00231

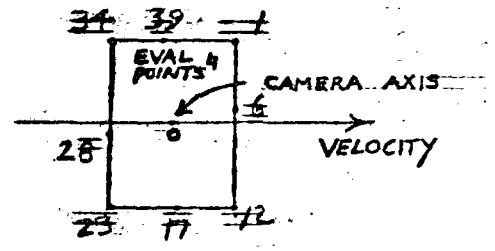
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00752° .229 KM σ_λ=.00443° .134 KM	σ_u=.00556° .168 KM σ_λ=.01116° .338 KM	σ_u=.00554° .168 KM σ_λ=.00843° .256 KM	σ_u=.01158° .351 KM σ_λ=.01110° .337 KM	σ_u=.01259° .382 KM σ_λ=.00680° .205 KM	σ_u=.01509° .458 KM σ_λ=.00604° .184 KM	σ_u=.01087° .330 KM σ_λ=.00292° .889 KM	σ_u=.01079° .327 KM σ_λ=.00715° .216 KM	σ_u=.00791° .240 KM σ_λ=.00755° .229 KM
NAVIGATION	σ_u=.00473 σ_λ=.00211	σ_u=.00474 σ_λ=.00212	σ_u=.00473 σ_λ=.00211	σ_u=.00478 σ_λ=.00210	σ_u=.00477 σ_λ=.00211	σ_u=.00476 σ_λ=.00214	σ_u=.00473 σ_λ=.00213	σ_u=.00475 σ_λ=.00212	σ_u=.00475 σ_λ=.00212
ATTITUDE	σ_u=.00546 σ_λ=.00300	σ_u=.00115 σ_λ=.00760	σ_u=.00133 σ_λ=.00376	σ_u=.00962 σ_λ=.00880	σ_u=.00838 σ_λ=.00612	σ_u=.01265 σ_λ=.00396	σ_u=.00964 σ_λ=.00323	σ_u=.00892 σ_λ=.00649	σ_u=.00590 σ_λ=.00663
CAMERA ON-TIME	σ_u=.00030 σ_λ=.00155	σ_u=.00031 σ_λ=.00155	σ_u=.00031 σ_λ=.00155	σ_u=.00031 σ_λ=.00155	σ_u=.00030 σ_λ=.00155	σ_u=.00029 σ_λ=.00156	σ_u=.00030 σ_λ=.00156	σ_u=.00031 σ_λ=.00156	σ_u=.00031 σ_λ=.00155
MOON RADIUS	σ_u=.00206 σ_λ=.00194	σ_u=.00264 σ_λ=.00774	σ_u=.00254 σ_λ=.00707	σ_u=.00948 σ_λ=.00625	σ_u=.00910 σ_λ=.00137	σ_u=.00672 σ_λ=.00372	σ_u=.00465 σ_λ=.00262	σ_u=.00378 σ_λ=.00145	σ_u=.00329 σ_λ=.00247

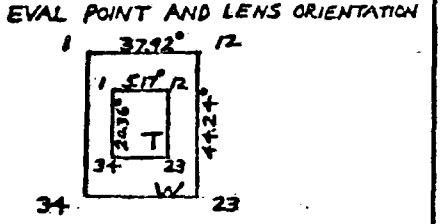
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION II FRAME 22





S/C ALTITUDE = 46.0 KM
TRUE ANOMALY = 359. °
INCLINATION = 12. °
NOTE:



TELEPHOTO LENS, T

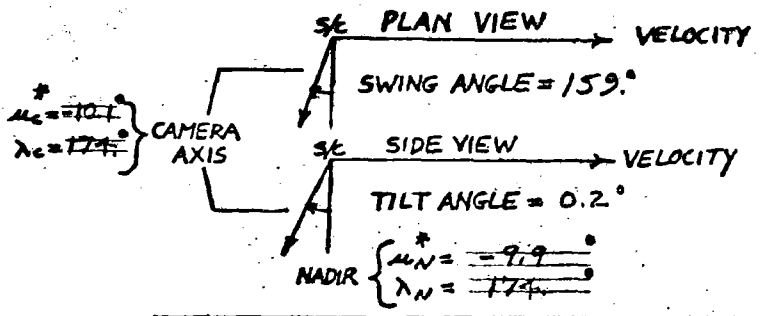
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00695° .211 KM σ_λ=.00354° .107 KM	σ_u=.00697° .211 KM σ_λ=.00438° .133 KM	σ_u=.00669° .203 KM σ_λ=.00376° .114 KM	σ_u=.00756° .229 KM σ_λ=.00363° .110 KM	σ_u=.00772° .235 KM σ_λ=.00350° .106 KM	σ_u=.00792° .240 KM σ_λ=.00356° .108 KM	σ_u=.00722° .219 KM σ_λ=.00399° .104 KM	σ_u=.00752° .228 KM σ_λ=.00401° .122 KM	σ_u=.00727° .220 KM σ_λ=.00413° .125 KM
NAVIGATION	σ_u=.00449 σ_λ=.00103	σ_u=.00449 σ_λ=.00103	σ_u=.00449 σ_λ=.00103	σ_u=.00449 σ_λ=.00103	σ_u=.00449 σ_λ=.00103	σ_u=.00449 σ_λ=.00103	σ_u=.00449 σ_λ=.00103	σ_u=.00449 σ_λ=.00103	σ_u=.00449 σ_λ=.00103
ATTITUDE	σ_u=.00530 σ_λ=.00274	σ_u=.00488 σ_λ=.00336	σ_u=.00496 σ_λ=.00278	σ_u=.00585 σ_λ=.00281	σ_u=.00573 σ_λ=.00277	σ_u=.00606 σ_λ=.00273	σ_u=.00564 σ_λ=.00272	σ_u=.00559 σ_λ=.00335	σ_u=.00524 σ_λ=.00335
CAMERA ON-TIME	σ_u=.00037 σ_λ=.00183	σ_u=.00037 σ_λ=.00183	σ_u=.00037 σ_λ=.00183	σ_u=.00037 σ_λ=.00183	σ_u=.00037 σ_λ=.00183	σ_u=.00037 σ_λ=.00183	σ_u=.00037 σ_λ=.00183	σ_u=.00037 σ_λ=.00183	σ_u=.00037 σ_λ=.00185
MOON RADIUS	σ_u=.00015 σ_λ=.00079	σ_u=.00212 σ_λ=.00186	σ_u=.00005 σ_λ=.00143	σ_u=.00265 σ_λ=.00091	σ_u=.00259 σ_λ=.00036	σ_u=.00240 σ_λ=.00029	σ_u=.00024 σ_λ=.00019	σ_u=.00239 σ_λ=.00066	σ_u=.00224 σ_λ=.00121

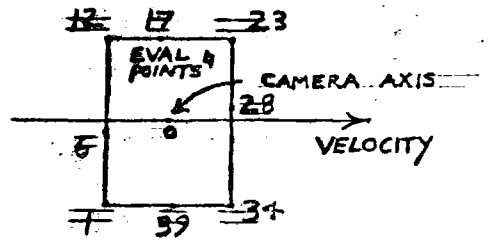
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00773° .235 KM σ_λ=.00360° .109 KM	σ_u=.00726° .220 KM σ_λ=.00917° .278 KM	σ_u=.00564° .171 KM σ_λ=.00677° .205 KM	σ_u=.00983° .299 KM σ_λ=.00729° .221 KM	σ_u=.01074° .325 KM σ_λ=.00447° .136 KM	σ_u=.01249° .379 KM σ_λ=.00613° .186 KM	σ_u=.01025° .312 KM σ_λ=.00533° .162 KM	σ_u=.01241° .375 KM σ_λ=.00609° .184 KM	σ_u=.00987° .299 KM σ_λ=.00592° .180 KM
NAVIGATION	σ_u=.00449 σ_λ=.00103	σ_u=.00451 σ_λ=.00105	σ_u=.00449 σ_λ=.00104	σ_u=.00451 σ_λ=.00102	σ_u=.00451 σ_λ=.00103	σ_u=.00450 σ_λ=.00105	σ_u=.00449 σ_λ=.00103	σ_u=.00451 σ_λ=.00103	σ_u=.00451 σ_λ=.00104
ATTITUDE	σ_u=.00628 σ_λ=.00282	σ_u=.00355 σ_λ=.00600	σ_u=.00334 σ_λ=.00324	σ_u=.00568 σ_λ=.00555	σ_u=.00795 σ_λ=.00395	σ_u=.01072 σ_λ=.00323	σ_u=.00921 σ_λ=.00310	σ_u=.00985 σ_λ=.00507	σ_u=.00698 σ_λ=.00533
CAMERA ON-TIME	σ_u=.00037 σ_λ=.00183	σ_u=.00036 σ_λ=.00184	σ_u=.00037 σ_λ=.00184	σ_u=.00037 σ_λ=.00184	σ_u=.00037 σ_λ=.00183	σ_u=.00036 σ_λ=.00184	σ_u=.00037 σ_λ=.00184	σ_u=.00037 σ_λ=.00184	σ_u=.00037 σ_λ=.00184
MOON RADIUS	σ_u=.00015 σ_λ=.00079	σ_u=.00445 σ_λ=.00660	σ_u=.00061 σ_λ=.00556	σ_u=.00662 σ_λ=.00437	σ_u=.00569 σ_λ=.00011	σ_u=.00455 σ_λ=.00476	σ_u=.00029 σ_λ=.00378	σ_u=.00605 σ_λ=.00265	σ_u=.00532 σ_λ=.00147

* σ_u = LATITUDE σ_λ = LONGITUDE

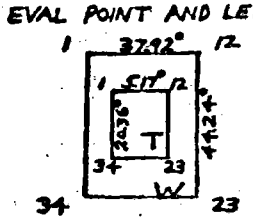
ERROR ANALYSIS RESULTS MISSION II FRAME 33





S/C ALTITUDE = ~~1452~~ KM
TRUE ANOMALY = ~~139.~~ °
INCLINATION ≈ ~~12.~~ °
NOTE: ~~R(178°) Y(0°) P(0°)~~

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

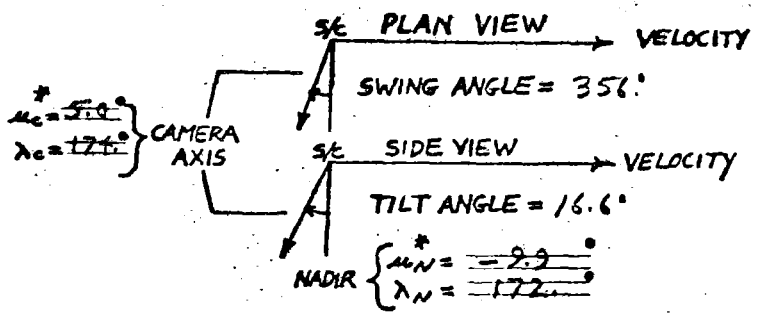
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$=.23658° 7.15 KM $\nabla\lambda$=.10970° 3.34 KM	$\nabla\mu$=.25306° 7.70 KM $\nabla\lambda$=.13044° 3.94 KM	$\nabla\mu$=.23230° 7.02 KM $\nabla\lambda$=.11127° 3.36 KM	$\nabla\mu$=.25326° 7.69 KM $\nabla\lambda$=.11324° 3.43 KM	$\nabla\mu$=.25694° 7.80 KM $\nabla\lambda$=.11244° 3.40 KM	$\nabla\mu$=.26237° 7.95 KM $\nabla\lambda$=.11290° 3.40 KM	$\nabla\mu$=.24185° 7.31 KM $\nabla\lambda$=.10961° 3.34 KM	$\nabla\mu$=.26368° 8.00 KM $\nabla\lambda$=.12648° 3.83 KM	$\nabla\mu$=.25894° 7.82 KM $\nabla\lambda$=.12752° 3.89 KM
NAVIGATION	$\nabla\mu$=.00511 $\nabla\lambda$=.00134	$\nabla\mu$=.00531 $\nabla\lambda$=.00133	$\nabla\mu$=.00512 $\nabla\lambda$=.00132	$\nabla\mu$=.00533 $\nabla\lambda$=.00132	$\nabla\mu$=.00532 $\nabla\lambda$=.00131	$\nabla\mu$=.00530 $\nabla\lambda$=.00131	$\nabla\mu$=.00511 $\nabla\lambda$=.00136	$\nabla\mu$=.00532 $\nabla\lambda$=.00144	$\nabla\mu$=.00532 $\nabla\lambda$=.00138
ATTITUDE	$\nabla\mu$=.23653 $\nabla\lambda$=.10969	$\nabla\mu$=.25296 $\nabla\lambda$=.13042	$\nabla\mu$=.23225 $\nabla\lambda$=.11125	$\nabla\mu$=.25316 $\nabla\lambda$=.11322	$\nabla\mu$=.25683 $\nabla\lambda$=.11242	$\nabla\mu$=.26228 $\nabla\lambda$=.11288	$\nabla\mu$=.24179 $\nabla\lambda$=.10959	$\nabla\mu$=.26358 $\nabla\lambda$=.12647	$\nabla\mu$=.25835 $\nabla\lambda$=.12751
CAMERA ON-TIME	$\nabla\mu$=.00012 $\nabla\lambda$=.00105	$\nabla\mu$=.00007 $\nabla\lambda$=.00108	$\nabla\mu$=.00011 $\nabla\lambda$=.00104	$\nabla\mu$=.00018 $\nabla\lambda$=.00102	$\nabla\mu$=.00019 $\nabla\lambda$=.00104	$\nabla\mu$=.00020 $\nabla\lambda$=.00106	$\nabla\mu$=.00013 $\nabla\lambda$=.00106	$\nabla\mu$=.00007 $\nabla\lambda$=.00111	$\nabla\mu$=.00007 $\nabla\lambda$=.00109
MOON RADIUS	$\nabla\mu$=.00006 $\nabla\lambda$=.00003	$\nabla\mu$=.00450 $\nabla\lambda$=.00149	$\nabla\mu$=.00038 $\nabla\lambda$=.00110	$\nabla\mu$=.00450 $\nabla\lambda$=.00083	$\nabla\mu$=.00443 $\nabla\lambda$=.00018	$\nabla\mu$=.00438 $\nabla\lambda$=.00140	$\nabla\mu$=.00027 $\nabla\lambda$=.00116	$\nabla\mu$=.00463 $\nabla\lambda$=.00100	$\nabla\mu$=.00457 $\nabla\lambda$=.00013

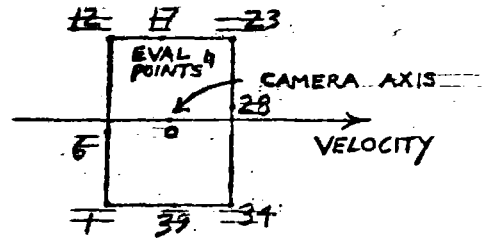
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$=.26018° 7.89 KM $\nabla\lambda$=.11119° 3.36 KM	$\nabla\mu$=.42869° 13.0 KM $\nabla\lambda$=.50700° 15.4 KM	$\nabla\mu$=.23260° 7.03 KM $\nabla\lambda$=.16042° 4.85 KM	$\nabla\mu$=.47556° 14.4 KM $\nabla\lambda$=.32120° 9.72 KM	$\nabla\mu$=.41395° 12.8 KM $\nabla\lambda$=.15652° 4.74 KM	$\nabla\mu$=.57767° 17.5 KM $\nabla\lambda$=.26604° 8.09 KM	$\nabla\mu$=.33828° 10.1 KM $\nabla\lambda$=.15218° 4.61 KM	$\nabla\mu$=.60011° 18.2 KM $\nabla\lambda$=.35123° 10.6 KM	$\nabla\mu$=.43168° 13.1 KM $\nabla\lambda$=.20142° 6.11 KM
NAVIGATION	$\nabla\mu$=.00511 $\nabla\lambda$=.00134	$\nabla\mu$=.00661 $\nabla\lambda$=.00293	$\nabla\mu$=.00514 $\nabla\lambda$=.00139	$\nabla\mu$=.00762 $\nabla\lambda$=.00310	$\nabla\mu$=.00654 $\nabla\lambda$=.00135	$\nabla\mu$=.00687 $\nabla\lambda$=.00205	$\nabla\mu$=.00507 $\nabla\lambda$=.00174	$\nabla\mu$=.00730 $\nabla\lambda$=.00500	$\nabla\mu$=.00653 $\nabla\lambda$=.00159
ATTITUDE	$\nabla\mu$=.26013 $\nabla\lambda$=.11118	$\nabla\mu$=.42833 $\nabla\lambda$=.50657	$\nabla\mu$=.23254 $\nabla\lambda$=.16010	$\nabla\mu$=.47529 $\nabla\lambda$=.32089	$\nabla\mu$=.41371 $\nabla\lambda$=.15651	$\nabla\mu$=.57741 $\nabla\lambda$=.26556	$\nabla\mu$=.33824 $\nabla\lambda$=.15183	$\nabla\mu$=.59985 $\nabla\lambda$=.35064	$\nabla\mu$=.43149 $\nabla\lambda$=.20141
CAMERA ON-TIME	$\nabla\mu$=.00012 $\nabla\lambda$=.00105	$\nabla\mu$=.00015 $\nabla\lambda$=.00851	$\nabla\mu$=.00007 $\nabla\lambda$=.00112	$\nabla\mu$=.00006 $\nabla\lambda$=.00113	$\nabla\mu$=.00031 $\nabla\lambda$=.00105	$\nabla\mu$=.00074 $\nabla\lambda$=.00169	$\nabla\mu$=.00021 $\nabla\lambda$=.00136	$\nabla\mu$=.00021 $\nabla\lambda$=.00182	$\nabla\mu$=.00001 $\nabla\lambda$=.00122
MOON RADIUS	$\nabla\mu$=.00006 $\nabla\lambda$=.00003	$\nabla\mu$=.01372 $\nabla\lambda$=.02070	$\nabla\mu$=.00002 $\nabla\lambda$=.00992	$\nabla\mu$=.01716 $\nabla\lambda$=.01382	$\nabla\mu$=.01242 $\nabla\lambda$=.00019	$\nabla\mu$=.01578 $\nabla\lambda$=.01578	$\nabla\mu$=.00088 $\nabla\lambda$=.00994	$\nabla\mu$=.01585 $\nabla\lambda$=.01955	$\nabla\mu$=.01273 $\nabla\lambda$=.00036

* μ = LATITUDE λ = LONGITUDE

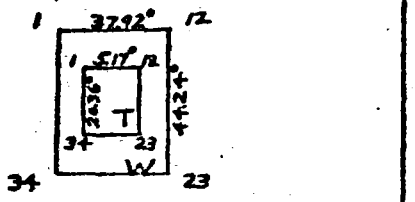
ERROR ANALYSIS RESULTS MISSION II FRAME 34





S/C ALTITUDE = 1450. KM
TRUE ANOMALY = 138. °
INCLINATION ≈ 12. °
NOTE: R(164°) Y(0°) P(0°)

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

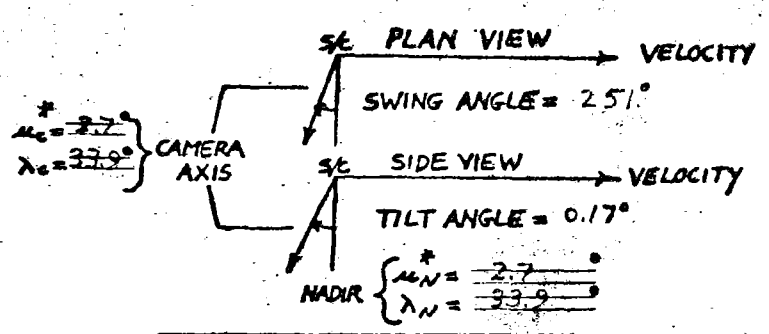
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.28851° 8.75 KM σ_λ=.12371° 3.74 KM	σ_u=.22702° 6.87 KM σ_λ=.12542° 3.80 KM	σ_u=.27632° 8.35 KM σ_λ=.12102° 3.66 KM	σ_u=.51978° 15.7 KM σ_λ=.15074° 4.56 KM	σ_u=.51814° 15.7 KM σ_λ=.15651° 4.75 KM	σ_u=.52377° 15.9 KM σ_λ=.17188° 5.20 KM	σ_u=.30315° 9.18 KM σ_λ=.12919° 3.91 KM	σ_u=.23580° 7.15 KM σ_λ=.12761° 3.86 KM	σ_u=.23143° 7.00 KM σ_λ=.12600° 3.82 KM
NAVIGATION	σ_u=.00600 σ_λ=.00234	σ_u=.00541 σ_λ=.00230	σ_u=.00595 σ_λ=.00231	σ_u=.00864 σ_λ=.00246	σ_u=.00849 σ_λ=.00251	σ_u=.00836 σ_λ=.00266	σ_u=.00606 σ_λ=.00238	σ_u=.00538 σ_λ=.00235	σ_u=.00539 σ_λ=.00232
ATTITUDE	σ_u=.28833 σ_λ=.12368	σ_u=.22694 σ_λ=.12539	σ_u=.27615 σ_λ=.12099	σ_u=.51933 σ_λ=.15072	σ_u=.51771 σ_λ=.15646	σ_u=.52336 σ_λ=.17179	σ_u=.30297 σ_λ=.12914	σ_u=.23572 σ_λ=.12758	σ_u=.23135 σ_λ=.12598
CAMERA ON-TIME	σ_u=.00026 σ_λ=.00105	σ_u=.00015 σ_λ=.00103	σ_u=.00023 σ_λ=.00103	σ_u=.00048 σ_λ=.00111	σ_u=.00052 σ_λ=.00115	σ_u=.00057 σ_λ=.00121	σ_u=.00029 σ_λ=.00108	σ_u=.00017 σ_λ=.00106	σ_u=.00016 σ_λ=.00104
MOON RADIUS	σ_u=.00806 σ_λ=.00090	σ_u=.00299 σ_λ=.00099	σ_u=.00773 σ_λ=.00042	σ_u=.01971 σ_λ=.00076	σ_u=.01916 σ_λ=.00262	σ_u=.01881 σ_λ=.00484	σ_u=.00848 σ_λ=.00228	σ_u=.00263 σ_λ=.00115	σ_u=.00278 σ_λ=.00018

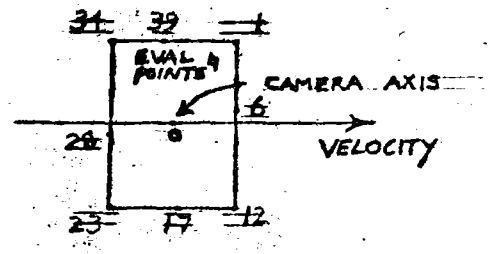
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.31901° 9.65 KM σ_λ=.12689° 3.85 KM	σ_u=.21793° 6.60 KM σ_λ=.22976° 6.95 KM	σ_u=.30013° 9.09 KM σ_λ=.17624° 5.33 KM	σ_u=ND° KM σ_λ=ND° KM	σ_u=ND° KM σ_λ=ND° KM	σ_u=ND° KM σ_λ=ND° KM	σ_u=.46614° 14.1 KM σ_λ=.27877° 8.45 KM	σ_u=.31485° 9.55 KM σ_λ=.19199° 5.81 KM	σ_u=.25172° 7.64 KM σ_λ=.16731° 5.05 KM
NAVIGATION	σ_u=.00600 σ_λ=.00234	σ_u=.00530 σ_λ=.00253	σ_u=.00646 σ_λ=.00291	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.00619 σ_λ=.00349	σ_u=.00539 σ_λ=.00304	σ_u=.00534 σ_λ=.00239
ATTITUDE	σ_u=.31886 σ_λ=.12686	σ_u=.21787 σ_λ=.22952	σ_u=.29986 σ_λ=.17587	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.46599 σ_λ=.27839	σ_u=.31478 σ_λ=.19178	σ_u=.25166 σ_λ=.16729
CAMERA ON-TIME	σ_u=.00026 σ_λ=.00105	σ_u=.00006 σ_λ=.00113	σ_u=.00007 σ_λ=.00109	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.00053 σ_λ=.00159	σ_u=.00009 σ_λ=.00130	σ_u=.00009 σ_λ=.00107
MOON RADIUS	σ_u=.00806 σ_λ=.00090	σ_u=.00056 σ_λ=.01017	σ_u=.01080 σ_λ=.01094	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.01004 σ_λ=.01404	σ_u=.00346 σ_λ=.00840	σ_u=.00235 σ_λ=.00007

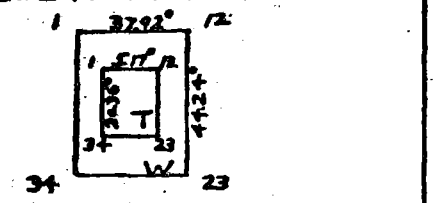
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION II FRAME 38





S/C ALTITUDE = 44.6 KM
TRUE ANOMALY = 1.7 °
INCLINATION = 12. °
NOTE: APOLLO 16 T P-7
t8



TELEPHOTO LENS, T

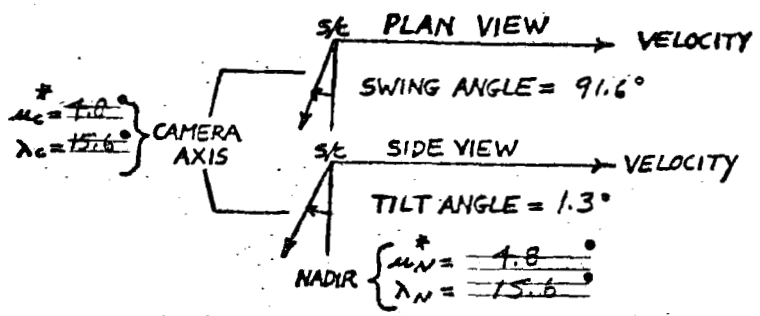
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00509° σ_λ=.00242° .1542 KM .0885 KM	σ_u=.00533° σ_λ=.00342° .1615 KM .1036 KM	σ_u=.00485° σ_λ=.00300° .1470 KM .0918 KM	σ_u=.00580° σ_λ=.00289° .1757 KM .0876 KM	σ_u=.00591° σ_λ=.00291° .1790 KM .0882 KM	σ_u=.00607° σ_λ=.00307° .1839 KM .0930 KM	σ_u=.00532° σ_λ=.00298° .1612 KM .0903 KM	σ_u=.00586° σ_λ=.00324° .1776 KM .0980 KM	σ_u=.00562° σ_λ=.00327° .1703 KM .0994 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.00508 σ_λ=.00265	σ_u=.00483 σ_λ=.00300	σ_u=.00484 σ_λ=.00266	σ_u=.00522 σ_λ=.00261	σ_u=.00540 σ_λ=.00260	σ_u=.00563 σ_λ=.00260	σ_u=.00532 σ_λ=.00265	σ_u=.00530 σ_λ=.00300	σ_u=.00507 σ_λ=.00300
CAMERA ON-TIME	σ_u=.000251 σ_λ=.00122	σ_u=.000250 σ_λ=.00122	σ_u=.000251 σ_λ=.00122	σ_u=.000253 σ_λ=.00122	σ_u=.000253 σ_λ=.00122	σ_u=.000252 σ_λ=.00122	σ_u=.000251 σ_λ=.00122	σ_u=.000250 σ_λ=.00122	σ_u=.000250 σ_λ=.00122
MOON RADIUS	σ_u=.0000055 σ_λ=.0000645	σ_u=.00224 σ_λ=.00109	σ_u=.0000856 σ_λ=.000646	σ_u=.00250 σ_λ=.000117	σ_u=.00239 σ_λ=.000425	σ_u=.00225 σ_λ=.00108	σ_u=.000967 σ_λ=.000633	σ_u=.00249 σ_λ=.000104	σ_u=.00237 σ_λ=.000438

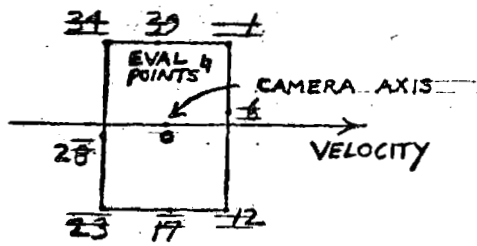
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00603° σ_λ=.00298° .1827 KM .0903 KM	σ_u=.0062° σ_λ=.00752° .1882 KM .2279 KM	σ_u=.00405° σ_λ=.00567° .1227 KM .1718 KM	σ_u=.00864° σ_λ=.00548° .2618 KM .1660 KM	σ_u=.00919° σ_λ=.00341° .2785 KM .1033 KM	σ_u=.0103° σ_λ=.00655° .3121 KM .1985 KM	σ_u=.00811° σ_λ=.00570° .2457 KM .1727 KM	σ_u=.0109° σ_λ=.00547° .3303 KM .1657 KM	σ_u=.00869° σ_λ=.00444° .2633 KM .1345 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.00603 σ_λ=.00272	σ_u=.00432 σ_λ=.00478	σ_u=.00402 σ_λ=.00301	σ_u=.00587 σ_λ=.00406	σ_u=.00738 σ_λ=.00311	σ_u=.00931 σ_λ=.00306	σ_u=.00810 σ_λ=.00309	σ_u=.00889 σ_λ=.00406	σ_u=.00676 σ_λ=.00421
CAMERA ON-TIME	σ_u=.000251 σ_λ=.00122	σ_u=.000245 σ_λ=.00123	σ_u=.000252 σ_λ=.00123	σ_u=.000261 σ_λ=.00122	σ_u=.000255 σ_λ=.00123	σ_u=.00025 σ_λ=.00123	σ_u=.00025 σ_λ=.00122	σ_u=.000252 σ_λ=.00123	σ_u=.000248 σ_λ=.00122
MOON RADIUS	σ_u=.0000550 σ_λ=.0000645	σ_u=.00445 σ_λ=.00568	σ_u=.000473 σ_λ=.00465	σ_u=.00634 σ_λ=.00346	σ_u=.00546 σ_λ=.000697	σ_u=.00447 σ_λ=.00566	σ_u=.000458 σ_λ=.00463	σ_u=.00632 σ_λ=.00345	σ_u=.00545 σ_λ=.000711

* σ_u = LATITUDE σ_λ = LONGITUDE

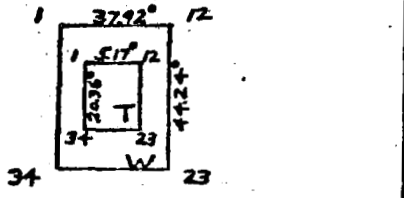
ERROR ANALYSIS RESULTS MISSION II FRAME 62





S/C ALTITUDE = ~~49.2~~ KM
TRUE ANOMALY = ~~35.~~ °
INCLINATION ≈ ~~12.~~ °
NOTE: ~~t 8~~

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

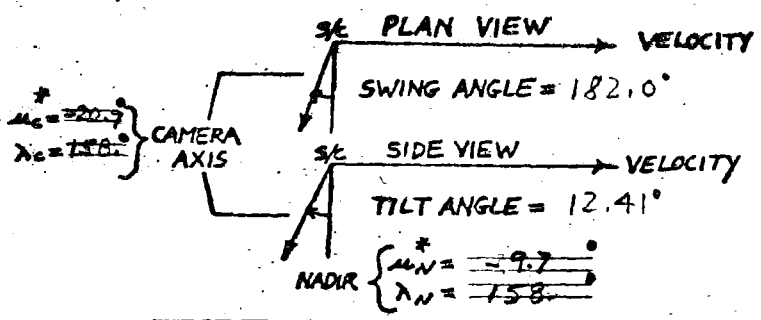
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00525° .159 KM σ_λ=.00321° .0972KM	σ_u=.00516° .153 KM σ_λ=.00399° .121 KM	σ_u=.00476° .144 KM σ_λ=.00322° .0975 KM	σ_u=.00584° .177 KM σ_λ=.00346° .105 KM	σ_u=.00616° .187 KM σ_λ=.00349° .106 KM	σ_u=.00658° .199 KM σ_λ=.00365° .111 KM	σ_u=.00573° .174 KM σ_λ=.00334° .101 KM	σ_u=.00610° .185 KM σ_λ=.00402° .122 KM	σ_u=.00567° .172 KM σ_λ=.00396° .120 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.00524 σ_λ=.00295	σ_u=.00495 σ_λ=.00373	σ_u=.00476 σ_λ=.00297	σ_u=.00530 σ_λ=.00323	σ_u=.00570 σ_λ=.00318	σ_u=.00619 σ_λ=.00314	σ_u=.00573 σ_λ=.00295	σ_u=.00553 σ_λ=.00380	σ_u=.00510 σ_λ=.00376
CAMERA ON-TIME	σ_u=.00024 σ_λ=.00122	σ_u=.00025 σ_λ=.00122	σ_u=.00024 σ_λ=.00122	σ_u=.00023 σ_λ=.00122	σ_u=.00023 σ_λ=.00122	σ_u=.00023 σ_λ=.00123	σ_u=.00024 σ_λ=.00122	σ_u=.00025 σ_λ=.00122	σ_u=.00025 σ_λ=.00122
MOON RADIUS	σ_u=.00006 σ_λ=.00034	σ_u=.00233 σ_λ=.00072	σ_u=.00016 σ_λ=.00030	σ_u=.00243 σ_λ=.00020	σ_u=.00233 σ_λ=.00014	σ_u=.00221 σ_λ=.00140	σ_u=.00003 σ_λ=.00098	σ_u=.00256 σ_λ=.00048	σ_u=.00246 σ_λ=.00006

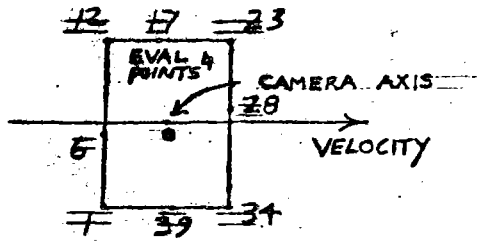
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00622° .189 KM σ_λ=.00328° .0994 KM	σ_u=.00503° .152 KM σ_λ=.00851° .258 KM	σ_u=.00223° .0675 KM σ_λ=.00554° .168 KM	σ_u=.00759° .230 KM σ_λ=.00741° .225 KM	σ_u=.00950° .288 KM σ_λ=.00542° .164 KM	σ_u=.01298° .393 KM σ_λ=.00754° .228 KM	σ_u=.01053° .320 KM σ_λ=.00629° .190 KM	σ_u=.01260° .382 KM σ_λ=.00780° .236 KM	σ_u=.00869° .263 KM σ_λ=.00660° .200 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.00622 σ_λ=.00302	σ_u=.00209 σ_λ=.00657	σ_u=.00219 σ_λ=.00329	σ_u=.00440 σ_λ=.00659	σ_u=.00780 σ_λ=.00519	σ_u=.01217 σ_λ=.00434	σ_u=.01052 σ_λ=.00353	σ_u=.01083 σ_λ=.00661	σ_u=.00668 σ_λ=.00648
CAMERA ON-TIME	σ_u=.00024 σ_λ=.00122	σ_u=.00025 σ_λ=.00121	σ_u=.00024 σ_λ=.00121	σ_u=.00022 σ_λ=.00121	σ_u=.00022 σ_λ=.00122	σ_u=.00021 σ_λ=.00125	σ_u=.00024 σ_λ=.00124	σ_u=.00027 σ_λ=.00124	σ_u=.00026 σ_λ=.00122
MOON RADIUS	σ_u=.00006 σ_λ=.00034	σ_u=.00457 σ_λ=.00526	σ_u=.00034 σ_λ=.00429	σ_u=.00619 σ_λ=.00318	σ_u=.00542 σ_λ=.00098	σ_u=.00453 σ_λ=.00604	σ_u=.00047 σ_λ=.00506	σ_u=.00643 σ_λ=.00395	σ_u=.00556 σ_λ=.00030

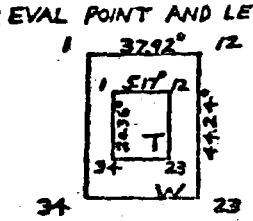
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION II FRAME 75





S/C ALTITUDE = 1466 KM
TRUE ANOMALY = 132 °
INCLINATION = 12. °
NOTE: ~~R(-165°) Y(10°) P(0°)~~



TELEPHOTO LENS, T

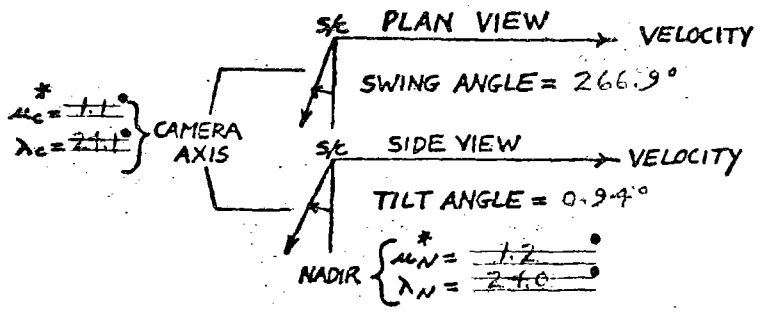
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.26583° 8.10KM σ_λ=.12008° 3.65KM	σ_u=.38768° 11.8 KM σ_λ=.16494° 5.00 KM	σ_u=.26681° 8.10 KM σ_λ=.12314° 3.74 KM	σ_u=.22896° 6.99 KM σ_λ=.11494° 3.50 KM	σ_u=.23287° 7.08 KM σ_λ=.11457° 3.50 KM	σ_u=.23829° 7.22 KM σ_λ=.11556° 3.52 KM	σ_u=.26625° 8.10 KM σ_λ=.11975° 3.63 KM	σ_u=.40087° 12.2 KM σ_λ=.15684° 4.75 KM	σ_u=.39362° 11.9 KM σ_λ=.15707° 4.75 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.26577 σ_λ=.12008	σ_u=.38745 σ_λ=.16492	σ_u=.26674 σ_λ=.12313	σ_u=.22896 σ_λ=.11492	σ_u=.23287 σ_λ=.11457	σ_u=.23829 σ_λ=.11555	σ_u=.26621 σ_λ=.11974	σ_u=.40060 σ_λ=.15682	σ_u=.39340 σ_λ=.15706
CAMERA ON-TIME	σ_u=.00004 σ_λ=.00110	σ_u=.00001 σ_λ=.00121	σ_u=.00006 σ_λ=.00110	σ_u=.00011 σ_λ=.00104	σ_u=.00011 σ_λ=.00105	σ_u=.00012 σ_λ=.00106	σ_u=.00007 σ_λ=.00111	σ_u=.00002 σ_λ=.00124	σ_u=.00001 σ_λ=.00122
MOON RADIUS	σ_u=.00563 σ_λ=.00001	σ_u=.01316 σ_λ=.00190	σ_u=.00617 σ_λ=.00138	σ_u=.00094 σ_λ=.00123	σ_u=.00092 σ_λ=.00022	σ_u=.00089 σ_λ=.00099	σ_u=.00511 σ_λ=.00128	σ_u=.01303 σ_λ=.00227	σ_u=.01306 σ_λ=.00038

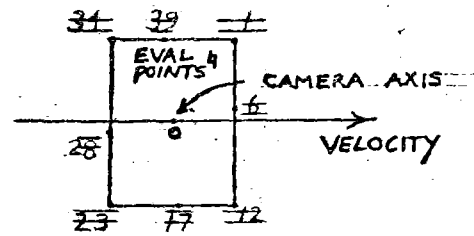
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.29389° 8.90 KM σ_λ=.12160° 3.70 KM	σ_u= ° KM σ_λ= ° KM N/D	σ_u=.28564° 8.70 KM σ_λ=.22640° 6.85 KM	σ_u=.25942° 7.86 KM σ_λ=.20686° 6.30 KM	σ_u=.27278° 8.29 KM σ_λ=.14454° 4.37 KM	σ_u=.34650° 10.5 KM σ_λ=.17213° 5.20 KM	σ_u=.36735° 11.1 KM σ_λ=.20205° 6.12 KM	σ_u= ° KM σ_λ= ° KM N/D	σ_u= ° KM σ_λ= ° KM N/D
NAVIGATION	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0 N/D	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0 N/D	σ_u=0 σ_λ=0 N/D
ATTITUDE	σ_u=.29375 σ_λ=.12159	σ_u= σ_λ= N/D	σ_u=.28554 σ_λ=.22598	σ_u=.25937 σ_λ=.20663	σ_u=.27274 σ_λ=.14453	σ_u=.34696 σ_λ=.17189	σ_u=.36732 σ_λ=.20172	σ_u= σ_λ= N/D	σ_u= σ_λ= N/D
CAMERA ON-TIME	σ_u=.00006 σ_λ=.00110	σ_u= σ_λ= N/D	σ_u=.00009 σ_λ=.00127	σ_u=.00007 σ_λ=.00108	σ_u=.00017 σ_λ=.00102	σ_u=.00032 σ_λ=.00131	σ_u=.00007 σ_λ=.00143	σ_u= σ_λ= N/D	σ_u= σ_λ= N/D
MOON RADIUS	σ_u=.00563 σ_λ=.00001	σ_u= σ_λ=	σ_u=.00750 σ_λ=.01374	σ_u=.00513 σ_λ=.00971	σ_u=.00431 σ_λ=.00095	σ_u=.00545 σ_λ=.00896	σ_u=.00437 σ_λ=.01145	σ_u= σ_λ=	σ_u= σ_λ=

* σ_u = LATITUDE σ_λ = LONGITUDE

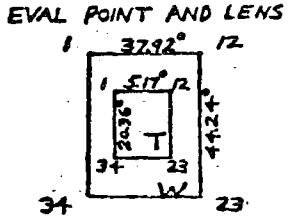
ERROR ANALYSIS RESULTS MISSION II FRAME 79





S/C ALTITUDE = 470 KM
TRUE ANOMALY = 8.6°
INCLINATION = 12°
NOTE: APOLLO TGT P-64
t8

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

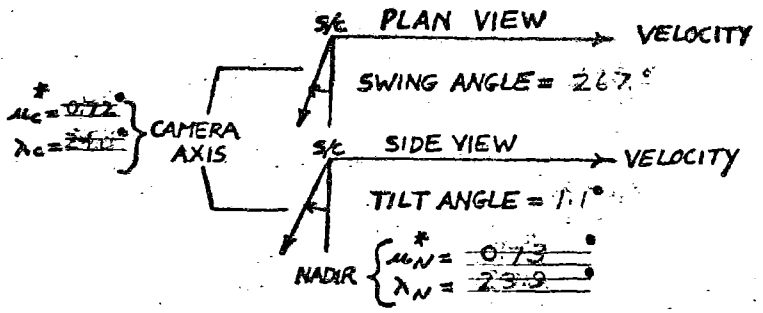
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00512° .1551 KM; σ_λ = .00417° .1263 KM	σ_u = .00550° .1667 KM; σ_λ = .00448° .1357 KM	σ_u = .00499° .1512 KM; σ_λ = .00426° .1291 KM	σ_u = .00586° .1776 KM; σ_λ = .00415° .1257 KM	σ_u = .00590° .1788 KM; σ_λ = .00414° .1254 KM	σ_u = .00596° .1803 KM; σ_λ = .00423° .1282 KM	σ_u = .00525° .1591 KM; σ_λ = .00419° .1270 KM	σ_u = .00585° .1773 KM; σ_λ = .00427° .1294 KM	σ_u = .00569° .1724 KM; σ_λ = .00432° .1309 KM
NAVIGATION	σ_u = .00115; σ_λ = .00281	σ_u = .00114; σ_λ = .00281	σ_u = .00115; σ_λ = .00281	σ_u = .00115; σ_λ = .00281	σ_u = .00115; σ_λ = .00280	σ_u = .00115; σ_λ = .00280	σ_u = .00115; σ_λ = .00281	σ_u = .00114; σ_λ = .00281	σ_u = .00114; σ_λ = .00281
ATTITUDE	σ_u = .00498; σ_λ = .00283	σ_u = .00490; σ_λ = .00301	σ_u = .00485; σ_λ = .00284	σ_u = .00515; σ_λ = .00279	σ_u = .00521; σ_λ = .00278	σ_u = .00536; σ_λ = .00279	σ_u = .00512; σ_λ = .00283	σ_u = .00518; σ_λ = .00298	σ_u = .00505; σ_λ = .00299
CAMERA ON-TIME	σ_u = .000256; σ_λ = .00121	σ_u = .000248; σ_λ = .00122	σ_u = .000256; σ_λ = .00122	σ_u = .000266; σ_λ = .00121	σ_u = .000265; σ_λ = .00121	σ_u = .000264; σ_λ = .00121	σ_u = .000257; σ_λ = .00121	σ_u = .000248; σ_λ = .00121	σ_u = .000248; σ_λ = .00122
MOON RADIUS	σ_u = .0000470; σ_λ = .000186	σ_u = .00220; σ_λ = .00128	σ_u = .0000919; σ_λ = .000827	σ_u = .00254; σ_λ = .000288	σ_u = .00243; σ_λ = .000254	σ_u = .00229; σ_λ = .000964	σ_u = .000136; σ_λ = .000451	σ_u = .00245; σ_λ = .0000846	σ_u = .00233; σ_λ = .000627

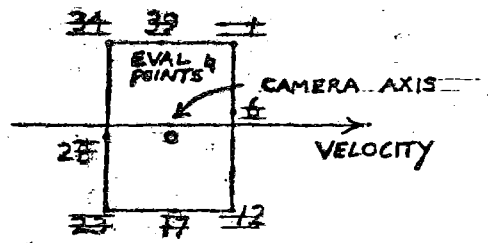
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00603° .1827 KM; σ_λ = .00422° .1279 KM	σ_u = .00696° .2210 KM; σ_λ = .00794° .2406 KM	σ_u = .00495° .1500 KM; σ_λ = .00661° .2003 KM	σ_u = .00918° .2782 KM; σ_λ = .00597° .1809 KM	σ_u = .00909° .2754 KM; σ_λ = .00426° .1291 KM	σ_u = .00931° .2821 KM; σ_λ = .00707° .2142 KM	σ_u = .00719° .2179 KM; σ_λ = .00628° .1901 KM	σ_u = .00103° .3121 KM; σ_λ = .00563° .1712 KM	σ_u = .00873° .2645 KM; σ_λ = .00480° .1454 KM
NAVIGATION	σ_u = .00115; σ_λ = .00281	σ_u = .00114; σ_λ = .00282	σ_u = .00115; σ_λ = .00282	σ_u = .00116; σ_λ = .00282	σ_u = .00116; σ_λ = .00280	σ_u = .00115; σ_λ = .00281	σ_u = .00115; σ_λ = .00281	σ_u = .00115; σ_λ = .00281	σ_u = .00115; σ_λ = .00281
ATTITUDE	σ_u = .00591; σ_λ = .00290	σ_u = .00525; σ_λ = .00432	σ_u = .00478; σ_λ = .00327	σ_u = .00644; σ_λ = .00360	σ_u = .00713; σ_λ = .00292	σ_u = .00803; σ_λ = .00326	σ_u = .00708; σ_λ = .00323	σ_u = .00808; σ_λ = .00347	σ_u = .00676; σ_λ = .00359
CAMERA ON-TIME	σ_u = .000256; σ_λ = .00121	σ_u = .000237; σ_λ = .00124	σ_u = .000259; σ_λ = .00124	σ_u = .000286; σ_λ = .00123	σ_u = .000277; σ_λ = .00121	σ_u = .000268; σ_λ = .00120	σ_u = .000255; σ_λ = .00120	σ_u = .000240; σ_λ = .00121	σ_u = .000237; σ_λ = .00122
MOON RADIUS	σ_u = .0000470; σ_λ = .000186	σ_u = .00442; σ_λ = .00591	σ_u = .000534; σ_λ = .00485	σ_u = .00643; σ_λ = .00364	σ_u = .00552; σ_λ = .000538	σ_u = .00447; σ_λ = .00548	σ_u = .000433; σ_λ = .00443	σ_u = .00627; σ_λ = .00324	σ_u = .00542; σ_λ = .000911

* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION II FRAME 87





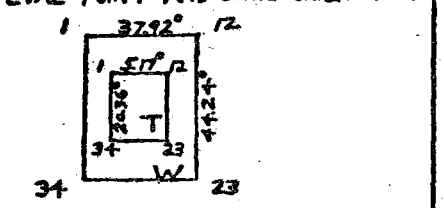
S/C ALTITUDE = 491 KM

TRUE ANOMALY = 10.6°

INCLINATION ≈ 43°

NOTE: APOLLO TST P-6 B

t8



TELEPHOTO LENS, T

ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00516° .156 KM; σ_λ = .00448° .136 KM	σ_u = .00557° .169 KM; σ_λ = .00474° .144 KM	σ_u = .00505° .153 KM; σ_λ = .00457° .139 KM	σ_u = .00591° .179 KM; σ_λ = .00447° .135 KM	σ_u = .00592° .179 KM; σ_λ = .00445° .135 KM	σ_u = .00595° .180 KM; σ_λ = .00453° .137 KM	σ_u = .00526° .159 KM; σ_λ = .00449° .136 KM	σ_u = .00567° .172 KM; σ_λ = .00455° .138 KM	σ_u = .00573° .174 KM; σ_λ = .00461° .140 KM
NAVIGATION	σ_u = .00123; σ_λ = .00311	σ_u = .00123; σ_λ = .00311	σ_u = .00123; σ_λ = .00311	σ_u = .00124; σ_λ = .00311	σ_u = .00124; σ_λ = .00311	σ_u = .00124; σ_λ = .00311	σ_u = .00123; σ_λ = .00311	σ_u = .00123; σ_λ = .00311	σ_u = .00123; σ_λ = .00311
ATTITUDE	σ_u = .00500; σ_λ = .00298	σ_u = .00496; σ_λ = .00312	σ_u = .00490; σ_λ = .00300	σ_u = .00517; σ_λ = .00295	σ_u = .00525; σ_λ = .00294	σ_u = .00534; σ_λ = .00295	σ_u = .00511; σ_λ = .00298	σ_u = .00513; σ_λ = .00309	σ_u = .00503; σ_λ = .00310
CAMERA ON-TIME	σ_u = .00026; σ_λ = .00121	σ_u = .00025; σ_λ = .00122	σ_u = .00026; σ_λ = .00122	σ_u = .00027; σ_λ = .00121	σ_u = .00027; σ_λ = .00121	σ_u = .00027; σ_λ = .00121	σ_u = .00026; σ_λ = .00121	σ_u = .00025; σ_λ = .00121	σ_u = .00025; σ_λ = .00121
MOON RADIUS	σ_u = .00006; σ_λ = .00023	σ_u = .00219; σ_λ = .00133	σ_u = .00303; σ_λ = .00088	σ_u = .00256; σ_λ = .00333	σ_u = .00244; σ_λ = .00021	σ_u = .00230; σ_λ = .00036	σ_u = .00015; σ_λ = .00041	σ_u = .00244; σ_λ = .00013	σ_u = .00233; σ_λ = .00038

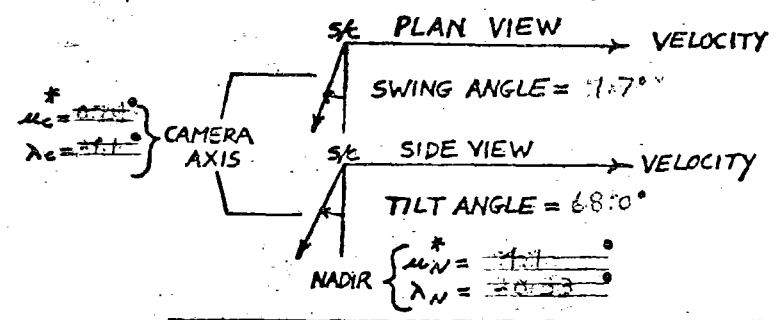
WIDE-ANGLE LENS, W

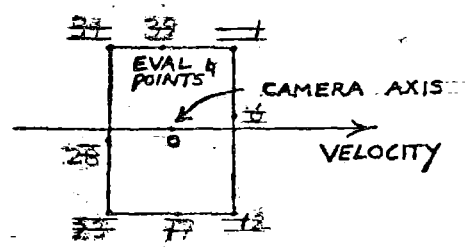
ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00306° .184 KM; σ_λ = .00433° .137 KM	σ_u = .00720° .218 KM; σ_λ = .00812° .246 KM	σ_u = .00521° .158 KM; σ_λ = .00699° .209 KM	σ_u = .00927° .284 KM; σ_λ = .00619° .187 KM	σ_u = .00911° .276 KM; σ_λ = .00454° .137 KM	σ_u = .00909° .275 KM; σ_λ = .00725° .220 KM	σ_u = .00699° .212 KM; σ_λ = .00645° .196 KM	σ_u = .0102° .310 KM; σ_λ = .00575° .175 KM	σ_u = .00878° .266 KM; σ_λ = .00498° .151 KM
NAVIGATION	σ_u = .00123; σ_λ = .00311	σ_u = .00122; σ_λ = .00315	σ_u = .00123; σ_λ = .00314	σ_u = .00126; σ_λ = .00313	σ_u = .00125; σ_λ = .00311	σ_u = .00124; σ_λ = .00310	σ_u = .00123; σ_λ = .00310	σ_u = .00123; σ_λ = .00310	σ_u = .00122; σ_λ = .00311
ATTITUDE	σ_u = .00533; σ_λ = .00305	σ_u = .00555; σ_λ = .00434	σ_u = .00503; σ_λ = .00396	σ_u = .00665; σ_λ = .00364	σ_u = .00712; σ_λ = .00304	σ_u = .00781; σ_λ = .00347	σ_u = .00687; σ_λ = .00339	σ_u = .00794; σ_λ = .00349	σ_u = .00684; σ_λ = .00356
CAMERA ON-TIME	σ_u = .00026; σ_λ = .00121	σ_u = .00023; σ_λ = .00124	σ_u = .00026; σ_λ = .00124	σ_u = .00029; σ_λ = .00123	σ_u = .00028; σ_λ = .00121	σ_u = .00027; σ_λ = .00119	σ_u = .00026; σ_λ = .00120	σ_u = .00024; σ_λ = .00120	σ_u = .00023; σ_λ = .00122
MOON RADIUS	σ_u = .00006; σ_λ = .00023	σ_u = .00442; σ_λ = .00598	σ_u = .00055; σ_λ = .00491	σ_u = .00647; σ_λ = .00370	σ_u = .00554; σ_λ = .00050	σ_u = .00449; σ_λ = .00593	σ_u = .00474; σ_λ = .00439	σ_u = .00626; σ_λ = .00318	σ_u = .00541; σ_λ = .00096

* μ = LATITUDE λ = LONGITUDE

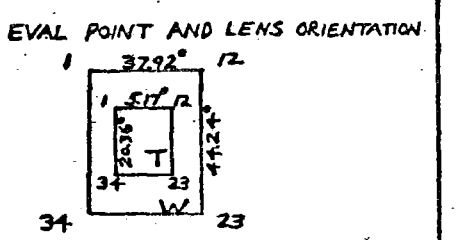
ERROR ANALYSIS RESULTS

MISSION II FRAME 93





s/c ALTITUDE = 442 KM
TRUE ANOMALY = 95.3°
INCLINATION ≈ 42°
NOTE: APOLLO TGT. S-7



TELEPHOTO LENS, T

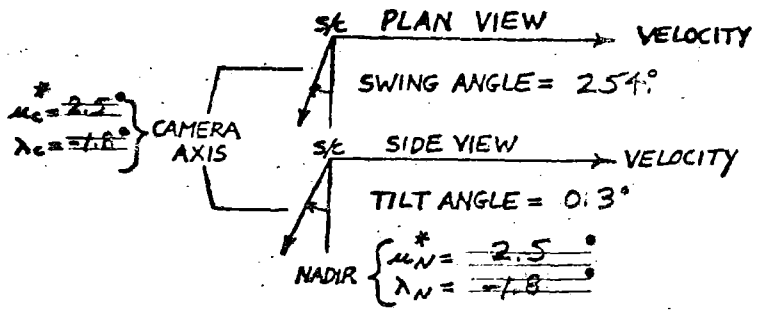
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.0621° 1.88 KM; σ_λ=.0155° .470 KM	σ_u=.0295° .893 KM; σ_λ=.00918° .278 KM	σ_u=.0553° 1.67 KM; σ_λ=.0123° .372 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=.0707° 2.14 KM; σ_λ=.0199° .603 KM	σ_u=.0305° .924 KM; σ_λ=.0116° .351 KM	σ_u=.0303° .919 KM; σ_λ=.0104° .315 KM
NAVIGATION	σ_u=.00144; σ_λ=.00335	σ_u=.00120; σ_λ=.00327	σ_u=.00139; σ_λ=.00331	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=.00151; σ_λ=.00341	σ_u=.00120; σ_λ=.00331	σ_u=.00120; σ_λ=.00329
ATTITUDE	σ_u=.0485; σ_λ=.0128	σ_u=.0190; σ_λ=.00762	σ_u=.0415; σ_λ=.0103	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=.0574; σ_λ=.0165	σ_u=.0209; σ_λ=.00924	σ_u=.0201; σ_λ=.0084
CAMERA ON-TIME	σ_u=.00020; σ_λ=.00186	σ_u=.00027; σ_λ=.00185	σ_u=.00022; σ_λ=.00185	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=.00016; σ_λ=.00188	σ_u=.00026; σ_λ=.00186	σ_u=.00027; σ_λ=.00185
MOON RADIUS	σ_u=.0387; σ_λ=.00782	σ_u=.0225; σ_λ=.00349	σ_u=.0365; σ_λ=.00576	σ_u= ↓; σ_λ= ↓	σ_u= ↓; σ_λ= ↓	σ_u= ↓; σ_λ= ↓	σ_u=.0413; σ_λ=.0134	σ_u=.0222; σ_λ=.00586	σ_u=.0223; σ_λ=.00478

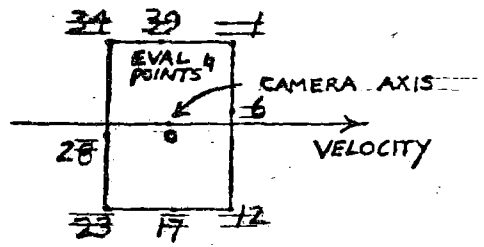
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 32
TOTAL	σ_u=.0689° 2.08 KM; σ_λ=.0169° .511 KM	σ_u=.0172° .521 KM; σ_λ=.00791° .240 KM	σ_u=.0462° 1.40 KM; σ_λ=.0106° .321 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=.122° 3.70 KM; σ_λ=.0719° 2.16 KM	σ_u=.0211° .639 KM; σ_λ=.0170° .515 KM	σ_u=.0189° .572 KM; σ_λ=.00959° .299 KM
NAVIGATION	σ_u=.00144; σ_λ=.00335	σ_u=.00114; σ_λ=.00320	σ_u=.00135; σ_λ=.00317	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=.00182; σ_λ=.00343	σ_u=.00112; σ_λ=.00330	σ_u=.00113; σ_λ=.00327
ATTITUDE	σ_u=.0569; σ_λ=.0145	σ_u=.00844; σ_λ=.00627	σ_u=.0291; σ_λ=.00312	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=.113; σ_λ=.0655	σ_u=.0165; σ_λ=.0126	σ_u=.0129; σ_λ=.00841
CAMERA ON-TIME	σ_u=.00020; σ_λ=.00186	σ_u=.00033; σ_λ=.00182	σ_u=.00033; σ_λ=.00182	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=.00005; σ_λ=.00209	σ_u=.00028; σ_λ=.00189	σ_u=.00030; σ_λ=.00185
MOON RADIUS	σ_u=.0387; σ_λ=.00782	σ_u=.0150; σ_λ=.00310	σ_u=.0359; σ_λ=.00576	σ_u= ↓; σ_λ= ↓	σ_u= ↓; σ_λ= ↓	σ_u= ↓; σ_λ= ↓	σ_u=.0461; σ_λ=.0230	σ_u=.0150; σ_λ=.00946	σ_u=.0128; σ_λ=.00361

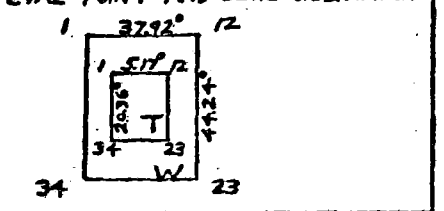
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION II FRAME 99





S/C ALTITUDE = 410 KM
TRUE ANOMALY = 1.1°
INCLINATION ≈ 12.°
NOTE: 1.8



TELEPHOTO LENS, T

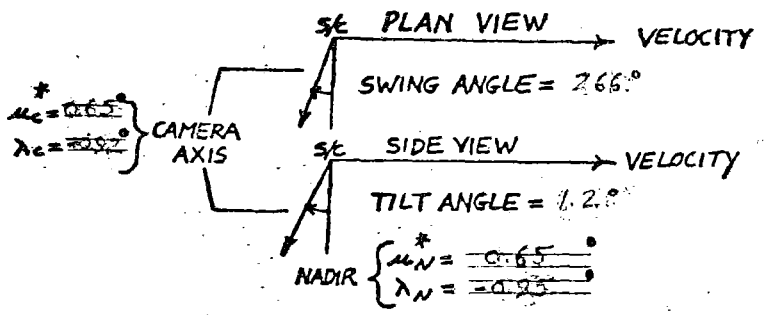
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u = .00481° .146 KM ∇_λ = .00442° .134 KM	∇_u = .00504° .153 KM ∇_λ = .00478° .145 KM	∇_u = .00455° .138 KM ∇_λ = .00447° .135 KM	∇_u = .00552° .167 KM ∇_λ = .00442° .134 KM	∇_u = .00566° .172 KM ∇_λ = .00443° .134 KM	∇_u = .00583° .176 KM ∇_λ = .00454° .137 KM	∇_u = .00507° .154 KM ∇_λ = .00447° .135 KM	∇_u = .00561° .170 KM ∇_λ = .00466° .141 KM	∇_u = .00535° .162 KM ∇_λ = .00468° .142 KM
NAVIGATION	∇_u = .00070 ∇_λ = .00348	∇_u = .00074 ∇_λ = .00345	∇_u = .00070 ∇_λ = .00346	∇_u = .00065 ∇_λ = .00347	∇_u = .00066 ∇_λ = .00349	∇_u = .00066 ∇_λ = .00350	∇_u = .00070 ∇_λ = .00349	∇_u = .00075 ∇_λ = .00348	∇_u = .00075 ∇_λ = .00347
ATTITUDE	∇_u = .00475 ∇_λ = .00244	∇_u = .00445 ∇_λ = .00285	∇_u = .00449 ∇_λ = .00245	∇_u = .00488 ∇_λ = .00244	∇_u = .00509 ∇_λ = .00242	∇_u = .00534 ∇_λ = .00241	∇_u = .00501 ∇_λ = .00243	∇_u = .00499 ∇_λ = .00285	∇_u = .00473 ∇_λ = .00285
CAMERA ON-TIME	∇_u = .00025 ∇_λ = .00122	∇_u = .00025 ∇_λ = .00122	∇_u = .00025 ∇_λ = .00122	∇_u = .00025 ∇_λ = .00122	∇_u = .00025 ∇_λ = .00122	∇_u = .00025 ∇_λ = .00122	∇_u = .00025 ∇_λ = .00122	∇_u = .00025 ∇_λ = .00122	∇_u = .00025 ∇_λ = .00122
MOON RADIUS	∇_u = .000003 ∇_λ = .00004	∇_u = .00224 ∇_λ = .00112	∇_u = .00009 ∇_λ = .00068	∇_u = .00249 ∇_λ = .00015	∇_u = .00238 ∇_λ = .00039	∇_u = .00225 ∇_λ = .00103	∇_u = .00009 ∇_λ = .00059	∇_u = .00248 ∇_λ = .00007	∇_u = .00237 ∇_λ = .00047

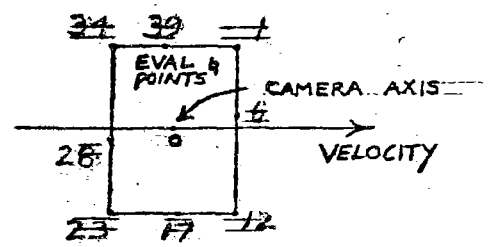
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u = .00569° .172 KM ∇_λ = .00446° .135 KM	∇_u = .00580° .176 KM ∇_λ = .00822° .249 KM	∇_u = .00352° .107 KM ∇_λ = .00652° .198 KM	∇_u = .00823° .249 KM ∇_λ = .00652° .198 KM	∇_u = .00886° .269 KM ∇_λ = .00488° .148 KM	∇_u = .01018° .308 KM ∇_λ = .00736° .223 KM	∇_u = .00797° .242 KM ∇_λ = .00659° .199 KM	∇_u = .01068° .323 KM ∇_λ = .00653° .198 KM	∇_u = .00835° .253 KM ∇_λ = .00566° .172 KM
NAVIGATION	∇_u = .00070 ∇_λ = .00348	∇_u = .00078 ∇_λ = .00337	∇_u = .00069 ∇_λ = .00339	∇_u = .00060 ∇_λ = .00341	∇_u = .00060 ∇_λ = .00349	∇_u = .00061 ∇_λ = .00361	∇_u = .00071 ∇_λ = .00359	∇_u = .00084 ∇_λ = .00356	∇_u = .00081 ∇_λ = .00346
ATTITUDE	∇_u = .00564 ∇_λ = .00250	∇_u = .00362 ∇_λ = .00471	∇_u = .00341 ∇_λ = .00277	∇_u = .00523 ∇_λ = .00414	∇_u = .00695 ∇_λ = .00312	∇_u = .00914 ∇_λ = .00287	∇_u = .00792 ∇_λ = .00285	∇_u = .00858 ∇_λ = .00411	∇_u = .00627 ∇_λ = .00425
CAMERA ON-TIME	∇_u = .00025 ∇_λ = .00122	∇_u = .00025 ∇_λ = .00123	∇_u = .00025 ∇_λ = .00123	∇_u = .00026 ∇_λ = .00122	∇_u = .00025 ∇_λ = .00122	∇_u = .00025 ∇_λ = .00122	∇_u = .00025 ∇_λ = .00122	∇_u = .00025 ∇_λ = .00122	∇_u = .00025 ∇_λ = .00122
MOON RADIUS	∇_u = .000003 ∇_λ = .00004	∇_u = .00445 ∇_λ = .00571	∇_u = .00047 ∇_λ = .00468	∇_u = .00632 ∇_λ = .00350	∇_u = .00545 ∇_λ = .00066	∇_u = .00445 ∇_λ = .00560	∇_u = .00046 ∇_λ = .00458	∇_u = .00630 ∇_λ = .00341	∇_u = .00545 ∇_λ = .00075

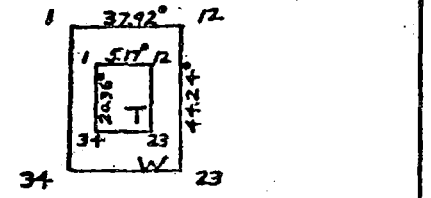
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION II FRAME 116





s/c ALTITUDE = 470 KM
TRUE ANOMALY = 9.5°
INCLINATION = 12°
NOTE: APOLLO TGT. P=8A
t8



TELEPHOTO LENS, T

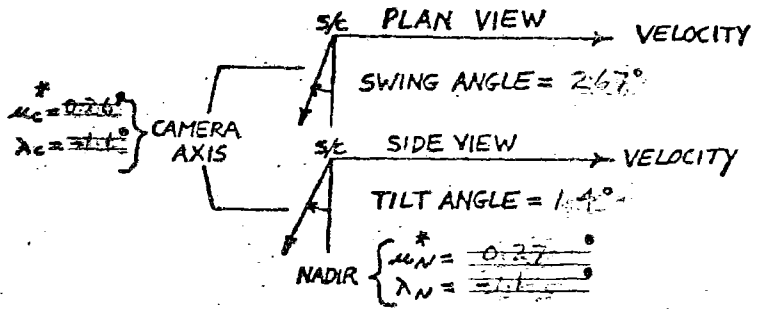
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u=.00511° .155 KM ∇_λ=.00377° .114 KM	∇_u=.00547° .166 KM ∇_λ=.00412° .125 KM	∇_u=.00494° .150 KM ∇_λ=.00389° .118 KM	∇_u=.00598° .177 KM ∇_λ=.00375° .114 KM	∇_u=.00590° .179 KM ∇_λ=.00373° .113 KM	∇_u=.00597° .179 KM ∇_λ=.00392° .116 KM	∇_u=.00525° .159 KM ∇_λ=.00378° .114 KM	∇_u=.00589° .177 KM ∇_λ=.00393° .118 KM	∇_u=.00567° .172 KM ∇_λ=.00396° .120 KM
NAVIGATION	∇_u=.00038 ∇_λ=.00153	∇_u=.00038 ∇_λ=.00153	∇_u=.00038 ∇_λ=.00153	∇_u=.00037 ∇_λ=.00153	∇_u=.00037 ∇_λ=.00154	∇_u=.00037 ∇_λ=.00154	∇_u=.00038 ∇_λ=.00154	∇_u=.00038 ∇_λ=.00153	∇_u=.00038 ∇_λ=.00153
ATTITUDE	∇_u=.00508 ∇_λ=.00321	∇_u=.00499 ∇_λ=.00339	∇_u=.00494 ∇_λ=.00323	∇_u=.00521 ∇_λ=.00318	∇_u=.00536 ∇_λ=.00317	∇_u=.00549 ∇_λ=.00317	∇_u=.00523 ∇_λ=.00321	∇_u=.00529 ∇_λ=.00336	∇_u=.00515 ∇_λ=.00337
CAMERA ON-TIME	∇_u=.00026 ∇_λ=.00121	∇_u=.00025 ∇_λ=.00122	∇_u=.00026 ∇_λ=.00122	∇_u=.00027 ∇_λ=.00121	∇_u=.00027 ∇_λ=.00121	∇_u=.00026 ∇_λ=.00121	∇_u=.00026 ∇_λ=.00121	∇_u=.00025 ∇_λ=.00121	∇_u=.00025 ∇_λ=.00122
MOON RADIUS	∇_u=.00005 ∇_λ=.00024	∇_u=.00219 ∇_λ=.00134	∇_u=.00003 ∇_λ=.00088	∇_u=.00255 ∇_λ=.00034	∇_u=.00244 ∇_λ=.00020	∇_u=.00230 ∇_λ=.00035	∇_u=.00014 ∇_λ=.00040	∇_u=.00244 ∇_λ=.00015	∇_u=.00235 ∇_λ=.00063

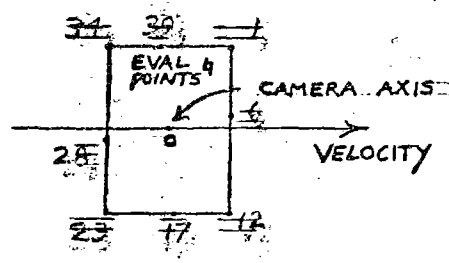
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u=.00604° .183 KM ∇_λ=.00382° .116 KM	∇_u=.00687° .203 KM ∇_λ=.00790° .239 KM	∇_u=.00486° .147 KM ∇_λ=.00647° .196 KM	∇_u=.00921° .279 KM ∇_λ=.00582° .176 KM	∇_u=.00916° .278 KM ∇_λ=.00388° .117 KM	∇_u=.00944° .286 KM ∇_λ=.00684° .207 KM	∇_u=.00721° .222 KM ∇_λ=.00602° .182 KM	∇_u=.0104° .315 KM ∇_λ=.00533° .162 KM	∇_u=.00871° .265 KM ∇_λ=.00454° .137 KM
NAVIGATION	∇_u=.00038 ∇_λ=.00153	∇_u=.00038 ∇_λ=.00152	∇_u=.00038 ∇_λ=.00153	∇_u=.00037 ∇_λ=.00153	∇_u=.00037 ∇_λ=.00154	∇_u=.00037 ∇_λ=.00156	∇_u=.00038 ∇_λ=.00155	∇_u=.00039 ∇_λ=.00155	∇_u=.00039 ∇_λ=.00153
ATTITUDE	∇_u=.00603 ∇_λ=.00327	∇_u=.00526 ∇_λ=.00477	∇_u=.00481 ∇_λ=.00371	∇_u=.00655 ∇_λ=.00405	∇_u=.00729 ∇_λ=.00352	∇_u=.00831 ∇_λ=.00368	∇_u=.00728 ∇_λ=.00364	∇_u=.00830 ∇_λ=.00390	∇_u=.00687 ∇_λ=.00398
CAMERA ON-TIME	∇_u=.00026 ∇_λ=.00121	∇_u=.00024 ∇_λ=.00124	∇_u=.00026 ∇_λ=.00124	∇_u=.00029 ∇_λ=.00123	∇_u=.00028 ∇_λ=.00121	∇_u=.00027 ∇_λ=.00120	∇_u=.00025 ∇_λ=.00120	∇_u=.00024 ∇_λ=.00120	∇_u=.00024 ∇_λ=.00122
MOON RADIUS	∇_u=.00005 ∇_λ=.00024	∇_u=.00441 ∇_λ=.00599	∇_u=.00055 ∇_λ=.00492	∇_u=.00646 ∇_λ=.00369	∇_u=.00552 ∇_λ=.00058	∇_u=.00446 ∇_λ=.00542	∇_u=.00444 ∇_λ=.00437	∇_u=.00626 ∇_λ=.00316	∇_u=.00541 ∇_λ=.00098

* u = LATITUDE λ = LONGITUDE

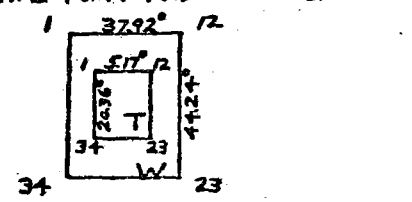
ERROR ANALYSIS RESULTS MISSION II FRAME 124





S/C ALTITUDE = 496 KM
TRUE ANOMALY = 11.2 °
INCLINATION ≈ 12 °
NOTE: APOLLO TGT P-88
t8

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

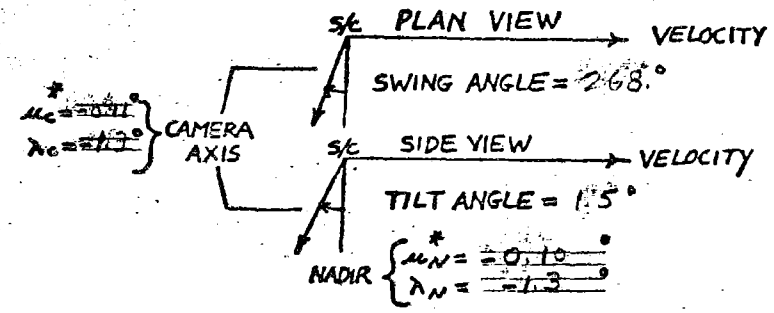
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00517° .157 KM σ_λ=.00405° .123 KM	σ_u=.00556° .169 KM σ_λ=.00439° .133 KM	σ_u=.00506° .153 KM σ_λ=.00416° .126 KM	σ_u=.00593° .180 KM σ_λ=.00404° .122 KM	σ_u=.00598° .180 KM σ_λ=.00402° .122 KM	σ_u=.00600° .182 KM σ_λ=.00410° .124 KM	σ_u=.00529° .160 KM σ_λ=.00406° .123 KM	σ_u=.00589° .178 KM σ_λ=.00414° .125 KM	σ_u=.00574° .174 KM σ_λ=.00421° .128 KM
NAVIGATION	σ_u=.00044 σ_λ=.00225	σ_u=.00044 σ_λ=.00225	σ_u=.00044 σ_λ=.00225	σ_u=.00044 σ_λ=.00225	σ_u=.00044 σ_λ=.00225	σ_u=.00044 σ_λ=.00225	σ_u=.00044 σ_λ=.00225	σ_u=.00044 σ_λ=.00225	σ_u=.00044 σ_λ=.00225
ATTITUDE	σ_u=.00515 σ_λ=.00314	σ_u=.00509 σ_λ=.00329	σ_u=.00503 σ_λ=.00316	σ_u=.00532 σ_λ=.00310	σ_u=.00541 σ_λ=.00310	σ_u=.00551 σ_λ=.00310	σ_u=.00527 σ_λ=.00314	σ_u=.00534 σ_λ=.00326	σ_u=.00523 σ_λ=.00327
CAMERA ON-TIME	σ_u=.00026 σ_λ=.00121	σ_u=.00025 σ_λ=.00122	σ_u=.00026 σ_λ=.00122	σ_u=.00027 σ_λ=.00121	σ_u=.00027 σ_λ=.00121	σ_u=.00027 σ_λ=.00121	σ_u=.00026 σ_λ=.00121	σ_u=.00025 σ_λ=.00121	σ_u=.00025 σ_λ=.00122
MOON RADIUS	σ_u=.00007 σ_λ=.00029	σ_u=.00218 σ_λ=.00138	σ_u=.00002 σ_λ=.00092	σ_u=.00257 σ_λ=.00038	σ_u=.00245 σ_λ=.00016	σ_u=.00231 σ_λ=.00081	σ_u=.00015 σ_λ=.00036	σ_u=.00243 σ_λ=.00019	σ_u=.00232 σ_λ=.00073

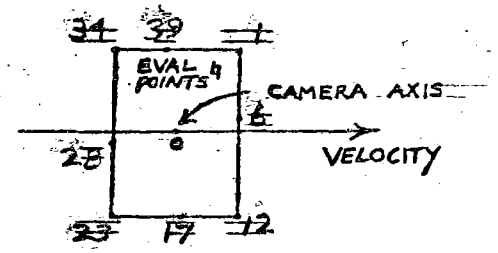
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00612° .185 KM σ_λ=.00411° .124 KM	σ_u=.00715° .216 KM σ_λ=.00801° .243 KM	σ_u=.00516° .156 KM σ_λ=.00668° .202 KM	σ_u=.00942° .285 KM σ_λ=.00597° .181 KM	σ_u=.00922° .279 KM σ_λ=.00412° .125 KM	σ_u=.00930° .282 KM σ_λ=.00697° .211 KM	σ_u=.00717° .217 KM σ_λ=.00616° .186 KM	σ_u=.0103° .312 KM σ_λ=.00547° .166 KM	σ_u=.00885° .268 KM σ_λ=.00467° .141 KM
NAVIGATION	σ_u=.00044 σ_λ=.00225	σ_u=.00044 σ_λ=.00226	σ_u=.00044 σ_λ=.00225	σ_u=.00045 σ_λ=.00225	σ_u=.00044 σ_λ=.00225	σ_u=.00044 σ_λ=.00225	σ_u=.00044 σ_λ=.00225	σ_u=.00045 σ_λ=.00225	σ_u=.00045 σ_λ=.00225
ATTITUDE	σ_u=.00610 σ_λ=.00321	σ_u=.00561 σ_λ=.00459	σ_u=.00510 σ_λ=.00364	σ_u=.00681 σ_λ=.00388	σ_u=.00735 σ_λ=.00321	σ_u=.00813 σ_λ=.00362	σ_u=.00714 σ_λ=.00355	σ_u=.00822 σ_λ=.00370	σ_u=.00699 σ_λ=.00377
CAMERA ON-TIME	σ_u=.00026 σ_λ=.00121	σ_u=.00023 σ_λ=.00125	σ_u=.00026 σ_λ=.00124	σ_u=.00029 σ_λ=.00123	σ_u=.00028 σ_λ=.00121	σ_u=.00027 σ_λ=.00119	σ_u=.00025 σ_λ=.00120	σ_u=.00023 σ_λ=.00120	σ_u=.00023 σ_λ=.00122
MOON RADIUS	σ_u=.00007 σ_λ=.00028	σ_u=.00641 σ_λ=.00604	σ_u=.00057 σ_λ=.00497	σ_u=.00649 σ_λ=.00374	σ_u=.00555 σ_λ=.00046	σ_u=.00448 σ_λ=.00539	σ_u=.00042 σ_λ=.00433	σ_u=.00625 σ_λ=.00312	σ_u=.00540 σ_λ=.00102

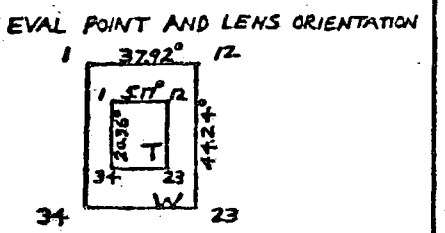
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION II FRAME 132





S/C ALTITUDE = 526 KM
TRUE ANOMALY = 12.9 °
INCLINATION ≈ 12 °
NOTE: Apollo 16 T P-8C
t8



TELEPHOTO LENS, T

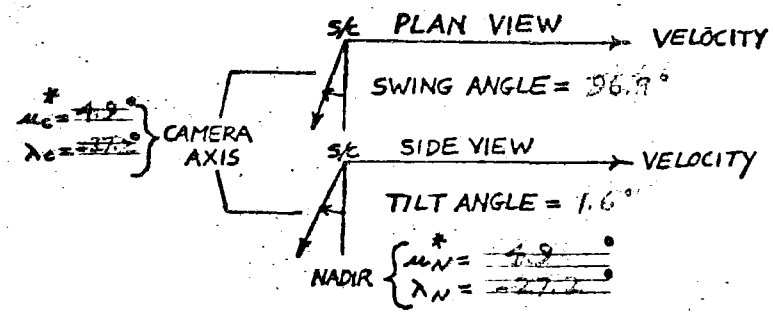
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.00522° .158 KM σ_λ=.00449° .136 KM	σ_μ=.00565° .171 KM σ_λ=.00478° .145 KM	σ_μ=.00513° .155 KM σ_λ=.00460° .139 KM	σ_μ=.00599° .181 KM σ_λ=.00448° .136 KM	σ_μ=.00599° .181 KM σ_λ=.00446° .135 KM	σ_μ=.0060° .182 KM σ_λ=.00453° .137 KM	σ_μ=.00532° .161 KM σ_λ=.00449° .136 KM	σ_μ=.00593° .180 KM σ_λ=.00455° .138 KM	σ_μ=.00580° .175 KM σ_λ=.00461° .140 KM
NAVIGATION	σ_μ=.00054 σ_λ=.00280	σ_μ=.00053 σ_λ=.00280	σ_μ=.00054 σ_λ=.00280	σ_μ=.00055 σ_λ=.00280	σ_μ=.00055 σ_λ=.00280	σ_μ=.00054 σ_λ=.00280	σ_μ=.00054 σ_λ=.00280	σ_μ=.00053 σ_λ=.00280	σ_μ=.00053 σ_λ=.00280
ATTITUDE	σ_μ=.00519 σ_λ=.00328	σ_μ=.00518 σ_λ=.00340	σ_μ=.00510 σ_λ=.00330	σ_μ=.00537 σ_λ=.00326	σ_μ=.00543 σ_λ=.00325	σ_μ=.00550 σ_λ=.00326	σ_μ=.00528 σ_λ=.00328	σ_μ=.00538 σ_λ=.00336	σ_μ=.00529 σ_λ=.00337
CAMERA ON-TIME	σ_μ=.00026 σ_λ=.00121	σ_μ=.00024 σ_λ=.00122	σ_μ=.00026 σ_λ=.00121	σ_μ=.00027 σ_λ=.00121	σ_μ=.00027 σ_λ=.00121	σ_μ=.00027 σ_λ=.00121	σ_μ=.00026 σ_λ=.00121	σ_μ=.00024 σ_λ=.00121	σ_μ=.00024 σ_λ=.00121
MOON RADIUS	σ_μ=.00007 σ_λ=.00031	σ_μ=.00218 σ_λ=.00140	σ_μ=.00001 σ_λ=.00095	σ_μ=.00258 σ_λ=.00041	σ_μ=.00246 σ_λ=.00014	σ_μ=.00233 σ_λ=.00079	σ_μ=.00016 σ_λ=.00034	σ_μ=.00243 σ_λ=.00021	σ_μ=.00231 σ_λ=.00075

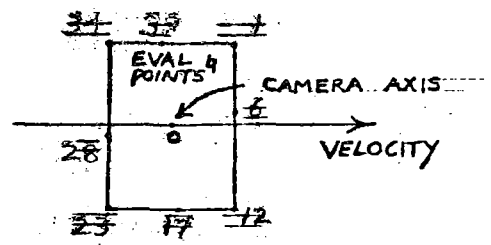
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.00618° .187 KM σ_λ=.00454° .138 KM	σ_μ=.00743° .225 KM σ_λ=.00823° .249 KM	σ_μ=.00545° .165 KM σ_λ=.00702° .213 KM	σ_μ=.00962° .292 KM σ_λ=.00627° .190 KM	σ_μ=.00925° .280 KM σ_λ=.00453° .137 KM	σ_μ=.00910° .276 KM σ_λ=.00725° .220 KM	σ_μ=.00699° .212 KM σ_λ=.00645° .195 KM	σ_μ=.01026° .311 KM σ_λ=.00573° .174 KM	σ_μ=.00892° .270 KM σ_λ=.00495° .150 KM
NAVIGATION	σ_μ=.00054 σ_λ=.00280	σ_μ=.00052 σ_λ=.00283	σ_μ=.00054 σ_λ=.00283	σ_μ=.00057 σ_λ=.00282	σ_μ=.00056 σ_λ=.00280	σ_μ=.00054 σ_λ=.00279	σ_μ=.00054 σ_λ=.00279	σ_μ=.00053 σ_λ=.00279	σ_μ=.00052 σ_λ=.00280
ATTITUDE	σ_μ=.00615 σ_λ=.00335	σ_μ=.00595 σ_λ=.00460	σ_μ=.00538 σ_λ=.00382	σ_μ=.00705 σ_λ=.00394	σ_μ=.00736 σ_λ=.00333	σ_μ=.00789 σ_λ=.00382	σ_μ=.00695 σ_λ=.00371	σ_μ=.00811 σ_λ=.00373	σ_μ=.00708 σ_λ=.00375
CAMERA ON-TIME	σ_μ=.00026 σ_λ=.00121	σ_μ=.00023 σ_λ=.00125	σ_μ=.00026 σ_λ=.00124	σ_μ=.00030 σ_λ=.00123	σ_μ=.00029 σ_λ=.00121	σ_μ=.00028 σ_λ=.00119	σ_μ=.00025 σ_λ=.00119	σ_μ=.00023 σ_λ=.00120	σ_μ=.00023 σ_λ=.00122
MOON RADIUS	σ_μ=.00007 σ_λ=.00031	σ_μ=.00442 σ_λ=.00608	σ_μ=.00057 σ_λ=.00501	σ_μ=.00652 σ_λ=.00379	σ_μ=.00557 σ_λ=.00043	σ_μ=.00450 σ_λ=.00537	σ_μ=.00041 σ_λ=.00431	σ_μ=.00625 σ_λ=.00311	σ_μ=.00541 σ_λ=.00104

* μ = LATITUDE λ = LONGITUDE

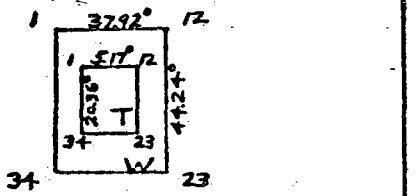
ERROR ANALYSIS RESULTS MISSION II FRAME 137





S/C ALTITUDE = 50.5 KM
TRUE ANOMALY = 348°
INCLINATION ≈ -12°
NOTE: APOLLO TGT. 5-11

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

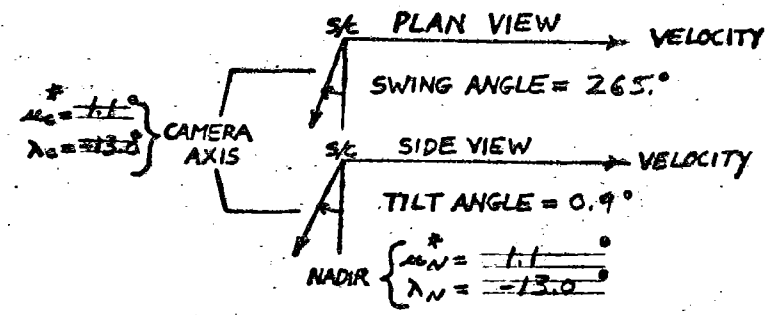
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00767° .231 KM σ_λ=.00383° .116 KM	σ_u=.00750° .227 KM σ_λ=.00463° .140 KM	σ_u=.00726° .220 KM σ_λ=.00382° .116 KM	σ_u=.00801° .243 KM σ_λ=.00424° .128 KM	σ_u=.00828° .251 KM σ_λ=.00426° .129 KM	σ_u=.00863° .261 KM σ_λ=.00439° .133 KM	σ_u=.00799° .242 KM σ_λ=.00395° .120 KM	σ_u=.00821° .249 KM σ_λ=.00471° .143 KM	σ_u=.00787° .238 KM σ_λ=.00463° .140 KM
NAVIGATION	σ_u=.00590 σ_λ=.00149	σ_u=.00588 σ_λ=.00148	σ_u=.00590 σ_λ=.00148	σ_u=.00593 σ_λ=.00149	σ_u=.00593 σ_λ=.00149	σ_u=.00593 σ_λ=.00150	σ_u=.00590 σ_λ=.00149	σ_u=.00588 σ_λ=.00149	σ_u=.00588 σ_λ=.00148
ATTITUDE	σ_u=.00479 σ_λ=.00299	σ_u=.00398 σ_λ=.00393	σ_u=.00421 σ_λ=.00300	σ_u=.00481 σ_λ=.00351	σ_u=.00530 σ_λ=.00345	σ_u=.00588 σ_λ=.00339	σ_u=.00538 σ_λ=.00299	σ_u=.00509 σ_λ=.00404	σ_u=.00458 σ_λ=.00398
CAMERA ON-TIME	σ_u=.00036 σ_λ=.00183	σ_u=.00038 σ_λ=.00183	σ_u=.00036 σ_λ=.00183	σ_u=.00034 σ_λ=.00183	σ_u=.00034 σ_λ=.00184	σ_u=.00034 σ_λ=.00184	σ_u=.00036 σ_λ=.00184	σ_u=.00038 σ_λ=.00184	σ_u=.00038 σ_λ=.00183
MOON RADIUS	σ_u=.00011 σ_λ=.00039	σ_u=.00238 σ_λ=.00067	σ_u=.00021 σ_λ=.00026	σ_u=.00238 σ_λ=.00024	σ_u=.00228 σ_λ=.00079	σ_u=.00216 σ_λ=.00145	σ_u=.00001 σ_λ=.00103	σ_u=.00262 σ_λ=.00053	σ_u=.00251 σ_λ=.00002

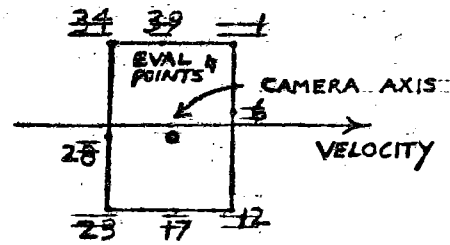
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 32
TOTAL	σ_u=.00820° .248 KM σ_λ=.00388° .118 KM	σ_u=.00757° .229 KM σ_λ=.00913° .276 KM	σ_u=.00604° .183 KM σ_λ=.00587° .178 KM	σ_u=.00915° .277 KM σ_λ=.00861° .261 KM	σ_u=.01083° .328 KM σ_λ=.00672° .204 KM	σ_u=.01463° .444 KM σ_λ=.00834° .252 KM	σ_u=.01238° .374 KM σ_λ=.00670° .203 KM	σ_u=.01396° .422 KM σ_λ=.00898° .272 KM	σ_u=.01007° .305 KM σ_λ=.00769° .233 KM
NAVIGATION	σ_u=.00590 σ_λ=.00149	σ_u=.00588 σ_λ=.00146	σ_u=.00590 σ_λ=.00144	σ_u=.00599 σ_λ=.00143	σ_u=.00598 σ_λ=.00150	σ_u=.00597 σ_λ=.00158	σ_u=.00589 σ_λ=.00154	σ_u=.00587 σ_λ=.00151	σ_u=.00587 σ_λ=.00148
ATTITUDE	σ_u=.00568 σ_λ=.00305	σ_u=.00112 σ_λ=.00712	σ_u=.00123 σ_λ=.00333	σ_u=.00318 σ_λ=.00768	σ_u=.00725 σ_λ=.00620	σ_u=.01257 σ_λ=.00515	σ_u=.01086 σ_λ=.00358	σ_u=.01086 σ_λ=.00767	σ_u=.00593 σ_λ=.00732
CAMERA ON-TIME	σ_u=.00036 σ_λ=.00183	σ_u=.00039 σ_λ=.00180	σ_u=.00036 σ_λ=.00181	σ_u=.00032 σ_λ=.00181	σ_u=.00032 σ_λ=.00184	σ_u=.00032 σ_λ=.00188	σ_u=.00036 σ_λ=.00188	σ_u=.00041 σ_λ=.00187	σ_u=.00040 σ_λ=.00183
MOON RADIUS	σ_u=.00011 σ_λ=.00039	σ_u=.00462 σ_λ=.00522	σ_u=.00030 σ_λ=.00424	σ_u=.00613 σ_λ=.00313	σ_u=.00537 σ_λ=.00102	σ_u=.00449 σ_λ=.00609	σ_u=.00052 σ_λ=.00512	σ_u=.00650 σ_λ=.00401	σ_u=.00562 σ_λ=.00025

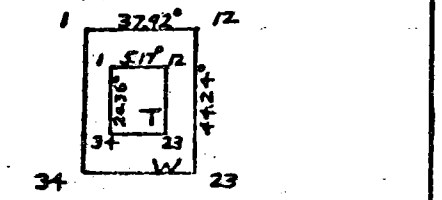
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION II FRAME 141





S/C ALTITUDE = 447 KM
TRUE ANOMALY = 6.6 °
INCLINATION = 12. °
NOTE: T8



TELEPHOTO LENS, T

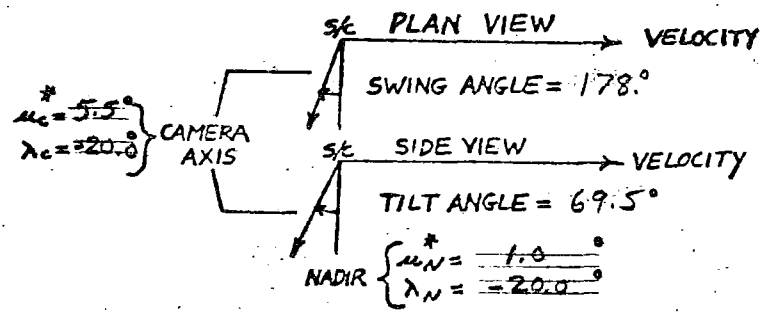
ERROR SOURCE	CAMERA AXIS (O)		EVAL POINT 1		EVAL POINT 6		EVAL POINT 12		EVAL POINT 17		EVAL POINT 23		EVAL POINT 28		EVAL POINT 34		EVAL POINT 39	
TOTAL	σ_u = .00529° .163 KM	σ_λ = .00478° .145 KM	σ_u = .00557° .169 KM	σ_λ = .00512° .155 KM	σ_u = .00510° .155 KM	σ_λ = .00487° .148 KM	σ_u = .00600° .182 KM	σ_λ = .00477° .145 KM	σ_u = .00608° .184 KM	σ_λ = .00476° .144 KM	σ_u = .00620° .187 KM	σ_λ = .00484° .147 KM	σ_u = .00548° .166 KM	σ_λ = .00481° .146 KM	σ_u = .00602° .182 KM	σ_λ = .00495° .150 KM	σ_u = .00582° .176 KM	σ_λ = .00499° .151 KM
NAVIGATION	σ_u = .00149	σ_λ = .00376	σ_u = .00151	σ_λ = .00377	σ_u = .00149	σ_λ = .00376	σ_u = .00148	σ_λ = .00376	σ_u = .00148	σ_λ = .00376	σ_u = .00148	σ_λ = .00376	σ_u = .00149	σ_λ = .00376	σ_u = .00151	σ_λ = .00376	σ_u = .00151	σ_λ = .00376
ATTITUDE	σ_u = .00507	σ_λ = .00270	σ_u = .00488	σ_λ = .00299	σ_u = .00487	σ_λ = .00272	σ_u = .00523	σ_λ = .00266	σ_u = .00538	σ_λ = .00265	σ_u = .00556	σ_λ = .00265	σ_u = .00527	σ_λ = .00270	σ_u = .00528	σ_λ = .00297	σ_u = .00510	σ_λ = .00297
CAMERA ON-TIME	σ_u = .00025	σ_λ = .00122	σ_u = .00025	σ_λ = .00122	σ_u = .00025	σ_λ = .00122	σ_u = .00026	σ_λ = .00122	σ_u = .00026	σ_λ = .00122	σ_u = .00026	σ_λ = .00121	σ_u = .00025	σ_λ = .00121	σ_u = .00025	σ_λ = .00122	σ_u = .00025	σ_λ = .00122
MOON RADIUS	σ_u = .00004	σ_λ = .00017	σ_u = .00221	σ_λ = .00127	σ_u = .00005	σ_λ = .00081	σ_u = .00253	σ_λ = .00027	σ_u = .00242	σ_λ = .00027	σ_u = .00228	σ_λ = .00092	σ_u = .00013	σ_λ = .00047	σ_u = .00245	σ_λ = .00007	σ_u = .00234	σ_λ = .00061

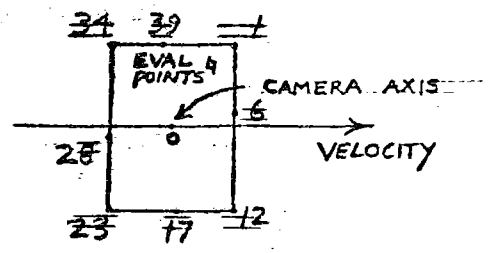
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS		EVAL POINT 1		EVAL POINT 6		EVAL POINT 12		EVAL POINT 17		EVAL POINT 23		EVAL POINT 28		EVAL POINT 34		EVAL POINT 39	
TOTAL	σ_u = .00620° .188 KM	σ_λ = .00483° .146 KM	σ_u = .00664° .201 KM	σ_λ = .00848° .257 KM	σ_u = .00462° .140 KM	σ_λ = .00699° .212 KM	σ_u = .00901° .273 KM	σ_λ = .00663° .201 KM	σ_u = .00929° .281 KM	σ_λ = .00498° .151 KM	σ_u = .01004° .304 KM	σ_λ = .00743° .225 KM	σ_u = .00789° .239 KM	σ_λ = .00670° .203 KM	σ_u = .01077° .326 KM	σ_λ = .00635° .192 KM	σ_u = .00882° .267 KM	σ_λ = .00567° .172 KM
NAVIGATION	σ_u = .00149	σ_λ = .00376	σ_u = .00153	σ_λ = .00381	σ_u = .00149	σ_λ = .00379	σ_u = .00145	σ_λ = .00378	σ_u = .00147	σ_λ = .00376	σ_u = .00148	σ_λ = .00376	σ_u = .00149	σ_λ = .00375	σ_u = .00153	σ_λ = .00375	σ_u = .00153	σ_λ = .00377
ATTITUDE	σ_u = .00602	σ_λ = .00277	σ_u = .00470	σ_λ = .00460	σ_u = .00434	σ_λ = .00311	σ_u = .00616	σ_λ = .00388	σ_u = .00734	σ_λ = .00299	σ_u = .00888	σ_λ = .00308	σ_u = .00773	σ_λ = .00311	σ_u = .00861	σ_λ = .00378	σ_u = .00679	σ_λ = .00395
CAMERA ON-TIME	σ_u = .00025	σ_λ = .00122	σ_u = .00024	σ_λ = .00124	σ_u = .00026	σ_λ = .00123	σ_u = .00028	σ_λ = .00123	σ_u = .00027	σ_λ = .00121	σ_u = .00026	σ_λ = .00121	σ_u = .00025	σ_λ = .00121	σ_u = .00024	σ_λ = .00121	σ_u = .00024	σ_λ = .00122
MOON RADIUS	σ_u = .00004	σ_λ = .00017	σ_u = .00442	σ_λ = .00589	σ_u = .00053	σ_λ = .00483	σ_u = .00641	σ_λ = .00362	σ_u = .00550	σ_λ = .00055	σ_u = .00445	σ_λ = .00548	σ_u = .00045	σ_λ = .00444	σ_u = .00628	σ_λ = .00324	σ_u = .00542	σ_λ = .00090

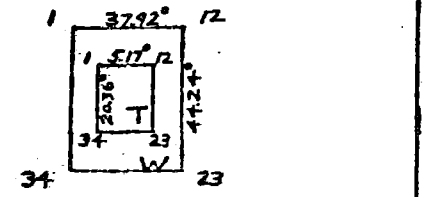
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION II FRAME 162





S/C ALTITUDE = 45.8 KM
TRUE ANOMALY = 6.9 °
INCLINATION ≈ -12. °
NOTE:



TELEPHOTO LENS, T

ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .07928° 2.41 KM, $\nabla\lambda$ = .00942° .276 KM	∇u = ° KM, $\nabla\lambda$ = ° KM ND	∇u = .08510° 2.58 KM, $\nabla\lambda$ = .00992° .301 KM	∇u = .03365° 1.02 KM, $\nabla\lambda$ = .00706° .214 KM	∇u = .03456° 1.04 KM, $\nabla\lambda$ = .00736° .223 KM	∇u = .03572° 1.08 KM, $\nabla\lambda$ = .00816° .247 KM	∇u = .07454° 2.26 KM, $\nabla\lambda$ = .01046° .317 KM	∇u = ° KM, $\nabla\lambda$ = ° KM ND	∇u = ° KM, $\nabla\lambda$ = ° KM ND
NAVIGATION	∇u = .00201, $\nabla\lambda$ = .00107	∇u = , $\nabla\lambda$ = N/D	∇u = .00208, $\nabla\lambda$ = .00107	∇u = .00171, $\nabla\lambda$ = .00106	∇u = .00171, $\nabla\lambda$ = .00106	∇u = .00171, $\nabla\lambda$ = .00107	∇u = .00196, $\nabla\lambda$ = .00107	∇u = , $\nabla\lambda$ = ° N/D	∇u = , $\nabla\lambda$ = N/D
ATTITUDE	∇u = .06562, $\nabla\lambda$ = .00918	∇u = , $\nabla\lambda$ = N/D	∇u = .07098, $\nabla\lambda$ = .00942	∇u = .02320, $\nabla\lambda$ = .00666	∇u = .02440, $\nabla\lambda$ = .00705	∇u = .02590, $\nabla\lambda$ = .00773	∇u = .06174, $\nabla\lambda$ = .01001	∇u = , $\nabla\lambda$ = N/D	∇u = , $\nabla\lambda$ = N/D
CAMERA ON-TIME	∇u = .00029, $\nabla\lambda$ = .00183	∇u = , $\nabla\lambda$ = N/D	∇u = .00027, $\nabla\lambda$ = .00184	∇u = .00031, $\nabla\lambda$ = .00183	∇u = .00031, $\nabla\lambda$ = .00183	∇u = .00032, $\nabla\lambda$ = .00183	∇u = .00032, $\nabla\lambda$ = .00183	∇u = , $\nabla\lambda$ = N/D	∇u = , $\nabla\lambda$ = N/D
MOON RADIUS	∇u = .04495, $\nabla\lambda$ = .00009	∇u = , $\nabla\lambda$ =	∇u = .04766, $\nabla\lambda$ = .00224	∇u = .02431, $\nabla\lambda$ = .00100	∇u = .02441, $\nabla\lambda$ = .00115	∇u = .02453, $\nabla\lambda$ = .00153	∇u = .04172, $\nabla\lambda$ = .00215	∇u = , $\nabla\lambda$ =	∇u = , $\nabla\lambda$ =

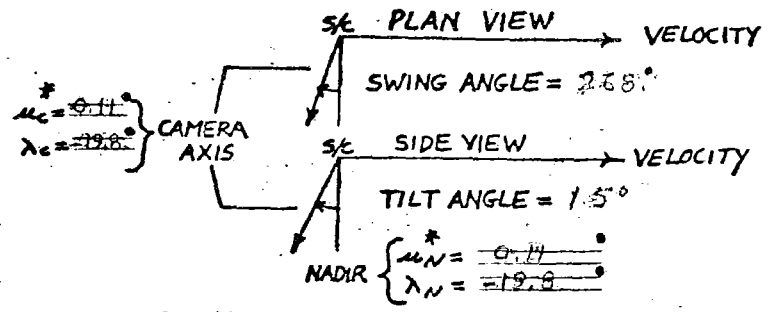
WIDE-ANGLE LENS, W

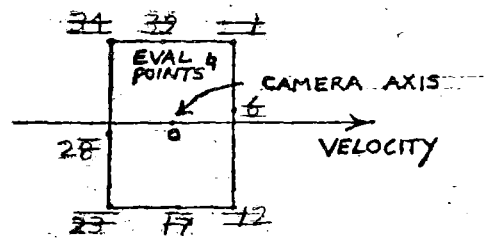
ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .08829° 2.68 KM, $\nabla\lambda$ = .00977° .296 KM	∇u = ° KM, $\nabla\lambda$ = ° KM ND	∇u = .09063° 2.44 KM, $\nabla\lambda$ = .02950° .894 KM	∇u = .01804° .545 KM, $\nabla\lambda$ = .00912° .280 KM	∇u = .02106° .637 KM, $\nabla\lambda$ = .00753° .228 KM	∇u = .02621° .793 KM, $\nabla\lambda$ = .01483° .448 KM	∇u = .10567° 3.21 KM, $\nabla\lambda$ = .04107° 1.24 KM	∇u = ° KM, $\nabla\lambda$ = ° KM ND	∇u = ° KM, $\nabla\lambda$ = ° KM N/D
NAVIGATION	∇u = .00201, $\nabla\lambda$ = .00168	∇u = , $\nabla\lambda$ = N/D	∇u = .00219, $\nabla\lambda$ = .00116	∇u = .00163, $\nabla\lambda$ = .00106	∇u = .00162, $\nabla\lambda$ = .00106	∇u = .00162, $\nabla\lambda$ = .00108	∇u = .00193, $\nabla\lambda$ = .00111	∇u = , $\nabla\lambda$ = N/D	∇u = , $\nabla\lambda$ = N/D
ATTITUDE	∇u = .07626, $\nabla\lambda$ = .00954	∇u = , $\nabla\lambda$ = N/D	∇u = .06204, $\nabla\lambda$ = .02256	∇u = .01024, $\nabla\lambda$ = .00663	∇u = .01465, $\nabla\lambda$ = .00722	∇u = .02102, $\nabla\lambda$ = .01287	∇u = .09702, $\nabla\lambda$ = .03788	∇u = , $\nabla\lambda$ = N/D	∇u = , $\nabla\lambda$ = N/D
CAMERA ON-TIME	∇u = .00029, $\nabla\lambda$ = .00183	∇u = , $\nabla\lambda$ = N/D	∇u = .00006, $\nabla\lambda$ = .00196	∇u = .00031, $\nabla\lambda$ = .00186	∇u = .00033, $\nabla\lambda$ = .00183	∇u = .00036, $\nabla\lambda$ = .00182	∇u = .00045, $\nabla\lambda$ = .00186	∇u = , $\nabla\lambda$ = N/D	∇u = , $\nabla\lambda$ = N/D
MOON RADIUS	∇u = .04445, $\nabla\lambda$ = .00009	∇u = , $\nabla\lambda$ =	∇u = .05146, $\nabla\lambda$ = .01886	∇u = .01476, $\nabla\lambda$ = .00607	∇u = .01564, $\nabla\lambda$ = .00021	∇u = .01556, $\nabla\lambda$ = .00707	∇u = .04184, $\nabla\lambda$ = .01572	∇u = , $\nabla\lambda$ =	∇u = , $\nabla\lambda$ =

* u = LATITUDE λ = LONGITUDE

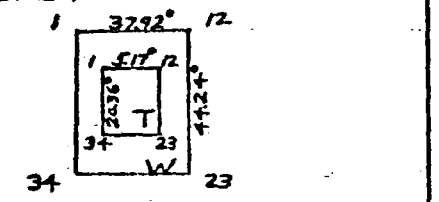
UB 4802 1435 ORIG: 4-65

ERROR ANALYSIS RESULTS MISSION II FRAME 160





S/C ALTITUDE = 520 KM
TRUE ANOMALY = 44.0°
INCLINATION = 12°
NOTE: APOLLO TST P-21A
t8



TELEPHOTO LENS, T

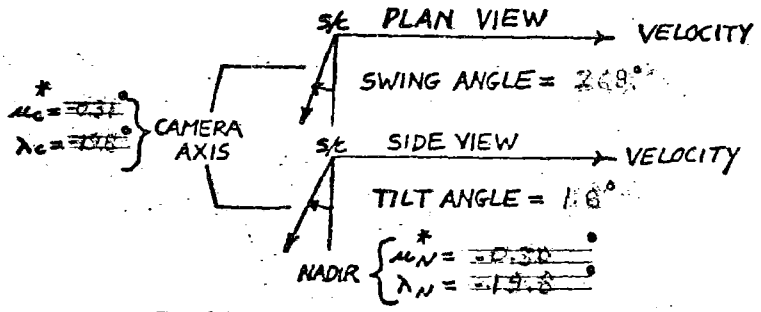
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$ = .00564° .171 KM $\nabla\lambda$ = .00437° .131 KM	$\nabla\mu$ = .00598° .181 KM $\nabla\lambda$ = .00467° .141 KM	$\nabla\mu$ = .00549° .166 KM $\nabla\lambda$ = .00442° .134 KM	$\nabla\mu$ = .00637° .193 KM $\nabla\lambda$ = .00429° .130 KM	$\nabla\mu$ = .00642° .194 KM $\nabla\lambda$ = .00427° .129 KM	$\nabla\mu$ = .00650° .197 KM $\nabla\lambda$ = .00434° .131 KM	$\nabla\mu$ = .00579° .175 KM $\nabla\lambda$ = .00431° .131 KM	$\nabla\mu$ = .00634° .192 KM $\nabla\lambda$ = .00443° .134 KM	$\nabla\mu$ = .00617° .187 KM $\nabla\lambda$ = .00450° .136 KM
NAVIGATION	$\nabla\mu$ = .00092 $\nabla\lambda$ = .00271	$\nabla\mu$ = .00093 $\nabla\lambda$ = .00270	$\nabla\mu$ = .00092 $\nabla\lambda$ = .00270	$\nabla\mu$ = .00091 $\nabla\lambda$ = .00271	$\nabla\mu$ = .00091 $\nabla\lambda$ = .00271	$\nabla\mu$ = .00091 $\nabla\lambda$ = .00272	$\nabla\mu$ = .00092 $\nabla\lambda$ = .00271	$\nabla\mu$ = .00093 $\nabla\lambda$ = .00271	$\nabla\mu$ = .00093 $\nabla\lambda$ = .00271
ATTITUDE	$\nabla\mu$ = .00556 $\nabla\lambda$ = .00312	$\nabla\mu$ = .00546 $\nabla\lambda$ = .00332	$\nabla\mu$ = .00541 $\nabla\lambda$ = .00313	$\nabla\mu$ = .00574 $\nabla\lambda$ = .00307	$\nabla\mu$ = .00586 $\nabla\lambda$ = .00306	$\nabla\mu$ = .00599 $\nabla\lambda$ = .00307	$\nabla\mu$ = .00571 $\nabla\lambda$ = .00311	$\nabla\mu$ = .00571 $\nabla\lambda$ = .00329	$\nabla\mu$ = .00563 $\nabla\lambda$ = .00330
CAMERA ON-TIME	$\nabla\mu$ = .00026 $\nabla\lambda$ = .00121	$\nabla\mu$ = .00025 $\nabla\lambda$ = .00122	$\nabla\mu$ = .00026 $\nabla\lambda$ = .00122	$\nabla\mu$ = .00027 $\nabla\lambda$ = .00121	$\nabla\mu$ = .00027 $\nabla\lambda$ = .00121	$\nabla\mu$ = .00027 $\nabla\lambda$ = .00121	$\nabla\mu$ = .00026 $\nabla\lambda$ = .00121	$\nabla\mu$ = .00024 $\nabla\lambda$ = .00121	$\nabla\mu$ = .00025 $\nabla\lambda$ = .00121
MOON RADIUS	$\nabla\mu$ = .00007 $\nabla\lambda$ = .00031	$\nabla\mu$ = .00218 $\nabla\lambda$ = .00140	$\nabla\mu$ = .00002 $\nabla\lambda$ = .00095	$\nabla\mu$ = .00258 $\nabla\lambda$ = .00041	$\nabla\mu$ = .00246 $\nabla\lambda$ = .00013	$\nabla\mu$ = .00232 $\nabla\lambda$ = .00079	$\nabla\mu$ = .00016 $\nabla\lambda$ = .00033	$\nabla\mu$ = .00243 $\nabla\lambda$ = .00021	$\nabla\mu$ = .00232 $\nabla\lambda$ = .00075

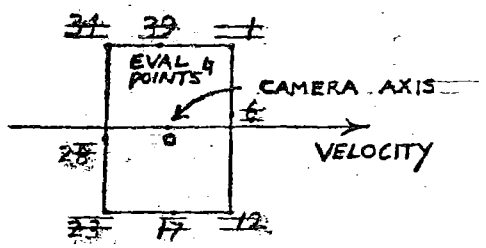
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$ = .00666° .202 KM $\nabla\lambda$ = .00437° .132 KM	$\nabla\mu$ = .00739° .224 KM $\nabla\lambda$ = .00831° .252 KM	$\nabla\mu$ = .00542° .164 KM $\nabla\lambda$ = .00685° .208 KM	$\nabla\mu$ = .00975° .296 KM $\nabla\lambda$ = .00629° .190 KM	$\nabla\mu$ = .00977° .296 KM $\nabla\lambda$ = .00442° .134 KM	$\nabla\mu$ = .01015° .308 KM $\nabla\lambda$ = .00711° .216 KM	$\nabla\mu$ = .00798° .242 KM $\nabla\lambda$ = .00633° .192 KM	$\nabla\mu$ = .01102° .334 KM $\nabla\lambda$ = .00578° .175 KM	$\nabla\mu$ = .00932° .283 KM $\nabla\lambda$ = .00508° .154 KM
NAVIGATION	$\nabla\mu$ = .00092 $\nabla\lambda$ = .00271	$\nabla\mu$ = .00095 $\nabla\lambda$ = .00269	$\nabla\mu$ = .00092 $\nabla\lambda$ = .00269	$\nabla\mu$ = .00090 $\nabla\lambda$ = .00269	$\nabla\mu$ = .00091 $\nabla\lambda$ = .00271	$\nabla\mu$ = .00091 $\nabla\lambda$ = .00276	$\nabla\mu$ = .00093 $\nabla\lambda$ = .00275	$\nabla\mu$ = .00096 $\nabla\lambda$ = .00274	$\nabla\mu$ = .00095 $\nabla\lambda$ = .00270
ATTITUDE	$\nabla\mu$ = .00659 $\nabla\lambda$ = .00319	$\nabla\mu$ = .00583 $\nabla\lambda$ = .00483	$\nabla\mu$ = .00531 $\nabla\lambda$ = .00362	$\nabla\mu$ = .00720 $\nabla\lambda$ = .00405	$\nabla\mu$ = .00798 $\nabla\lambda$ = .00324	$\nabla\mu$ = .00904 $\nabla\lambda$ = .00357	$\nabla\mu$ = .00791 $\nabla\lambda$ = .00354	$\nabla\mu$ = .00903 $\nabla\lambda$ = .00384	$\nabla\mu$ = .00753 $\nabla\lambda$ = .00399
CAMERA ON-TIME	$\nabla\mu$ = .00026 $\nabla\lambda$ = .00121	$\nabla\mu$ = .00023 $\nabla\lambda$ = .00124	$\nabla\mu$ = .00026 $\nabla\lambda$ = .00124	$\nabla\mu$ = .00029 $\nabla\lambda$ = .00123	$\nabla\mu$ = .00028 $\nabla\lambda$ = .00121	$\nabla\mu$ = .00027 $\nabla\lambda$ = .00119	$\nabla\mu$ = .00025 $\nabla\lambda$ = .00120	$\nabla\mu$ = .00023 $\nabla\lambda$ = .00120	$\nabla\mu$ = .00023 $\nabla\lambda$ = .00122
MOON RADIUS	$\nabla\mu$ = .00007 $\nabla\lambda$ = .00031	$\nabla\mu$ = .00443 $\nabla\lambda$ = .00607	$\nabla\mu$ = .00056 $\nabla\lambda$ = .00501	$\nabla\mu$ = .00651 $\nabla\lambda$ = .00379	$\nabla\mu$ = .00557 $\nabla\lambda$ = .00042	$\nabla\mu$ = .00450 $\nabla\lambda$ = .00536	$\nabla\mu$ = .0004 $\nabla\lambda$ = .00431	$\nabla\mu$ = .00625 $\nabla\lambda$ = .00311	$\nabla\mu$ = .00541 $\nabla\lambda$ = .00104

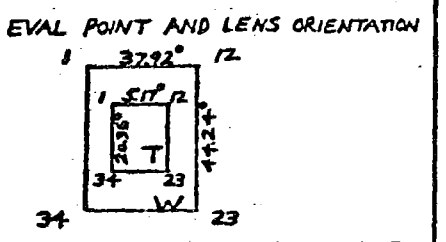
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION II FRAME 174





S/C ALTITUDE = 54 KM
TRUE ANOMALY = 12.9°
INCLINATION ≈ 12°
NOTE: APOLLO TGT. P-11B
t8



TELEPHOTO LENS, T

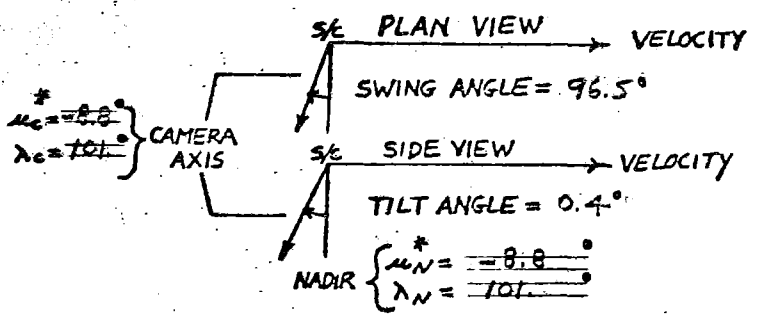
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .00571° .173 KM; $\nabla\lambda$ = .00372° .113 KM	∇u = .00606° .184 KM; $\nabla\lambda$ = .00414° .125 KM	∇u = .00558° .172 KM; $\nabla\lambda$ = .00387° .117 KM	∇u = .00646° .196 KM; $\nabla\lambda$ = .00371° .112 KM	∇u = .00649° .196 KM; $\nabla\lambda$ = .00366° .111 KM	∇u = .00654° .198 KM; $\nabla\lambda$ = .00374° .113 KM	∇u = .00584° .177 KM; $\nabla\lambda$ = .00371° .112 KM	∇u = .00640° .194 KM; $\nabla\lambda$ = .00383° .116 KM	∇u = .00624° .189 KM; $\nabla\lambda$ = .00392° .119 KM
NAVIGATION	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0
ATTITUDE	∇u = .00570 $\nabla\lambda$ = .00350	∇u = .00565 $\nabla\lambda$ = .00366	∇u = .00558 $\nabla\lambda$ = .00352	∇u = .00590 $\nabla\lambda$ = .00347	∇u = .00589 $\nabla\lambda$ = .00346	∇u = .00610 $\nabla\lambda$ = .00346	∇u = .00583 $\nabla\lambda$ = .00349	∇u = .00592 $\nabla\lambda$ = .00362	∇u = .00580 $\nabla\lambda$ = .00363
CAMERA ON-TIME	∇u = .00026 $\nabla\lambda$ = .00121	∇u = .00024 $\nabla\lambda$ = .00122	∇u = .00026 $\nabla\lambda$ = .00121	∇u = .00027 $\nabla\lambda$ = .00121	∇u = .00027 $\nabla\lambda$ = .00121	∇u = .00027 $\nabla\lambda$ = .00121	∇u = .00026 $\nabla\lambda$ = .00121	∇u = .00024 $\nabla\lambda$ = .00121	∇u = .00024 $\nabla\lambda$ = .00121
MOON RADIUS	∇u = .00009 $\nabla\lambda$ = .00038	∇u = .00217 $\nabla\lambda$ = .00148	∇u = .000002 $\nabla\lambda$ = .00103	∇u = .00260 $\nabla\lambda$ = .00049	∇u = .00248 $\nabla\lambda$ = .00006	∇u = .00234 $\nabla\lambda$ = .00071	∇u = .00018 $\nabla\lambda$ = .00026	∇u = .00242 $\nabla\lambda$ = .00028	∇u = .00231 $\nabla\lambda$ = .00083

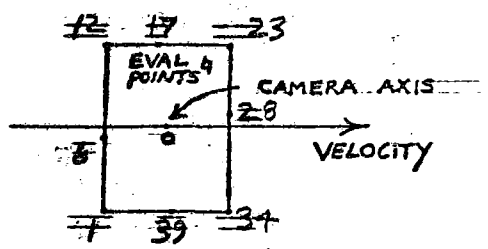
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .00676° .204 KM; $\nabla\lambda$ = .00379° .115 KM	∇u = .00770° .233 KM; $\nabla\lambda$ = .00811° .246 KM	∇u = .00574° .174 KM; $\nabla\lambda$ = .00666° .202 KM	∇u = .01005° .304 KM; $\nabla\lambda$ = .00596° .181 KM	∇u = .00988° .299 KM; $\nabla\lambda$ = .00379° .115 KM	∇u = .01002° .304 KM; $\nabla\lambda$ = .00675° .204 KM	∇u = .00786° .238 KM; $\nabla\lambda$ = .00591° .179 KM	∇u = .01101° .334 KM; $\nabla\lambda$ = .00522° .158 KM	∇u = .00946° .287 KM; $\nabla\lambda$ = .00448° .136 KM
NAVIGATION	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0
ATTITUDE	∇u = .00676 $\nabla\lambda$ = .00357	∇u = .00629 $\nabla\lambda$ = .00510	∇u = .00571 $\nabla\lambda$ = .00409	∇u = .00762 $\nabla\lambda$ = .00434	∇u = .00814 $\nabla\lambda$ = .00358	∇u = .00894 $\nabla\lambda$ = .00402	∇u = .00785 $\nabla\lambda$ = .00394	∇u = .00906 $\nabla\lambda$ = .00408	∇u = .00775 $\nabla\lambda$ = .00416
CAMERA ON-TIME	∇u = .00026 $\nabla\lambda$ = .00121	∇u = .00023 $\nabla\lambda$ = .00125	∇u = .00026 $\nabla\lambda$ = .00124	∇u = .00030 $\nabla\lambda$ = .00123	∇u = .00029 $\nabla\lambda$ = .00121	∇u = .00027 $\nabla\lambda$ = .00119	∇u = .00025 $\nabla\lambda$ = .00119	∇u = .00023 $\nabla\lambda$ = .00120	∇u = .00023 $\nabla\lambda$ = .00121
MOON RADIUS	∇u = .00009 $\nabla\lambda$ = .00038	∇u = .00444 $\nabla\lambda$ = .00618	∇u = .00058 $\nabla\lambda$ = .00510	∇u = .00655 $\nabla\lambda$ = .00389	∇u = .00559 $\nabla\lambda$ = .00035	∇u = .00452 $\nabla\lambda$ = .00529	∇u = .00039 $\nabla\lambda$ = .00424	∇u = .00624 $\nabla\lambda$ = .00304	∇u = .00541 $\nabla\lambda$ = .00111

* u = LATITUDE λ = LONGITUDE

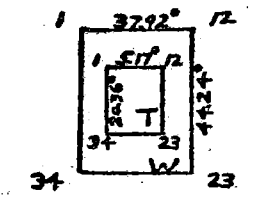
ERROR ANALYSIS RESULTS MISSION II FRAME 196





S/C ALTITUDE = 1517 KM
TRUE ANOMALY = 143. °
INCLINATION ≈ 12. °
NOTE: R(-178°) Y(0°) P(0°)

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

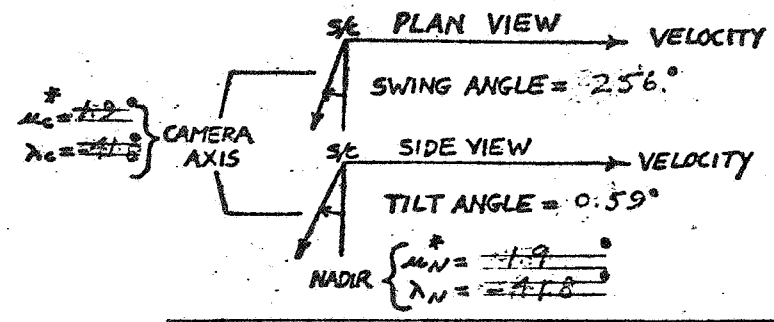
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.23409° 7.09 KM, σ_λ=.09807° 2.97 KM	σ_u=.24971° 7.55 KM, σ_λ=.11879° 3.62 KM	σ_u=.22897° 6.91 KM, σ_λ=.09938° 3.01 KM	σ_u=.25090° 7.60 KM, σ_λ=.10255° 3.12 KM	σ_u=.25544° 7.71 KM, σ_λ=.10174° 3.09 KM	σ_u=.26190° 7.92 KM, σ_λ=.10214° 3.09 KM	σ_u=.24023° 7.30 KM, σ_λ=.09815° 2.97 KM	σ_u=.26195° 7.93 KM, σ_λ=.11489° 3.48 KM	σ_u=.25598° 7.75 KM, σ_λ=.11594° 3.50 KM
NAVIGATION	σ_u=.00533, σ_λ=.00043	σ_u=.00554, σ_λ=.00044	σ_u=.00533, σ_λ=.00042	σ_u=.00555, σ_λ=.00042	σ_u=.00557, σ_λ=.00042	σ_u=.00556, σ_λ=.00042	σ_u=.00533, σ_λ=.00043	σ_u=.00555, σ_λ=.00097	σ_u=.00555, σ_λ=.00099
ATTITUDE	σ_u=.23903, σ_λ=.09806	σ_u=.24961, σ_λ=.11878	σ_u=.22891, σ_λ=.09937	σ_u=.25079, σ_λ=.10254	σ_u=.25535, σ_λ=.10173	σ_u=.26180, σ_λ=.10212	σ_u=.24017, σ_λ=.09814	σ_u=.26185, σ_λ=.11488	σ_u=.25588, σ_λ=.11593
CAMERA ON-TIME	σ_u=.00014, σ_λ=.00102	σ_u=.00009, σ_λ=.00105	σ_u=.00013, σ_λ=.00102	σ_u=.00019, σ_λ=.00100	σ_u=.00020, σ_λ=.00101	σ_u=.00022, σ_λ=.00104	σ_u=.00015, σ_λ=.00104	σ_u=.00009, σ_λ=.00108	σ_u=.00009, σ_λ=.00106
MOON RADIUS	σ_u=0, σ_λ=.00021	σ_u=.00454, σ_λ=.00125	σ_u=.00035, σ_λ=.00093	σ_u=.00965, σ_λ=.00072	σ_u=.00960, σ_λ=.00032	σ_u=.00957, σ_λ=.00157	σ_u=.00035, σ_λ=.00135	σ_u=.00966, σ_λ=.00128	σ_u=.00961, σ_λ=.00013

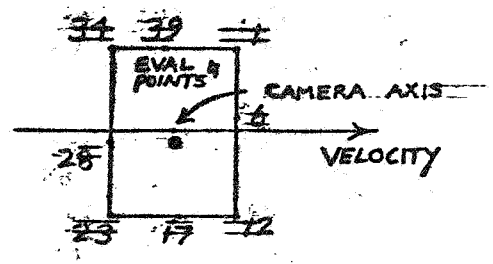
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.26005° .708 KM, σ_λ=.09880° 3.02 KM	σ_u=.43301° 13.1 KM, σ_λ=.50911° 15.4 KM	σ_u=.22497° 6.80 KM, σ_λ=.74424° 4.36 KM	σ_u=.48516° 14.7 KM, σ_λ=.34129° 9.72 KM	σ_u=.42484° 12.8 KM, σ_λ=.15163° 4.60 KM	σ_u=.63446° 19.2 KM, σ_λ=.29350° 8.90 KM	σ_u=.34680° 10.5 KM, σ_λ=.14113° 4.27 KM	σ_u=.63919° 19.4 KM, σ_λ=.38539° 11.6 KM	σ_u=.93911° 13.3 KM, σ_λ=.18978° 5.74 KM
NAVIGATION	σ_u=.00533, σ_λ=.00043	σ_u=.00716, σ_λ=.00367	σ_u=.00533, σ_λ=.00055	σ_u=.00801, σ_λ=.00248	σ_u=.00699, σ_λ=.00093	σ_u=.00788, σ_λ=.00286	σ_u=.00533, σ_λ=.00057	σ_u=.00777, σ_λ=.00955	σ_u=.00693, σ_λ=.00059
ATTITUDE	σ_u=.26000, σ_λ=.09979	σ_u=.43271, σ_λ=.50866	σ_u=.22490, σ_λ=.14390	σ_u=.48475, σ_λ=.34094	σ_u=.42458, σ_λ=.15163	σ_u=.63416, σ_λ=.29289	σ_u=.34676, σ_λ=.14073	σ_u=.63892, σ_λ=.38469	σ_u=.93886, σ_λ=.18977
CAMERA ON-TIME	σ_u=.00014, σ_λ=.00102	σ_u=.00020, σ_λ=.00152	σ_u=.00009, σ_λ=.00110	σ_u=.00007, σ_λ=.00114	σ_u=.00633, σ_λ=.00109	σ_u=.00084, σ_λ=.00182	σ_u=.00022, σ_λ=.00135	σ_u=.00021, σ_λ=.00187	σ_u=.00002, σ_λ=.00119
MOON RADIUS	σ_u=0, σ_λ=.00021	σ_u=.01449, σ_λ=.02181	σ_u=.00008, σ_λ=.00986	σ_u=.01808, σ_λ=.01503	σ_u=.01305, σ_λ=.00011	σ_u=.01785, σ_λ=.01859	σ_u=.00107, σ_λ=.01085	σ_u=.01694, σ_λ=.02259	σ_u=.01309, σ_λ=.00088

* μ = LATITUDE λ = LONGITUDE

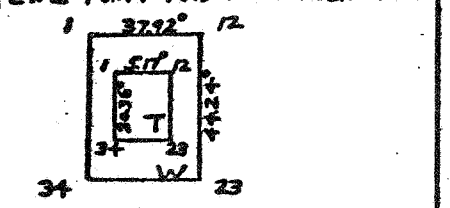
ERROR ANALYSIS RESULTS MISSION II FRAME 200





S/C ALTITUDE = 153 KM
TRUE ANOMALY = 1.8°
INCLINATION = 12°
NOTE: APOLLO 1ST. P-13A
t8

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

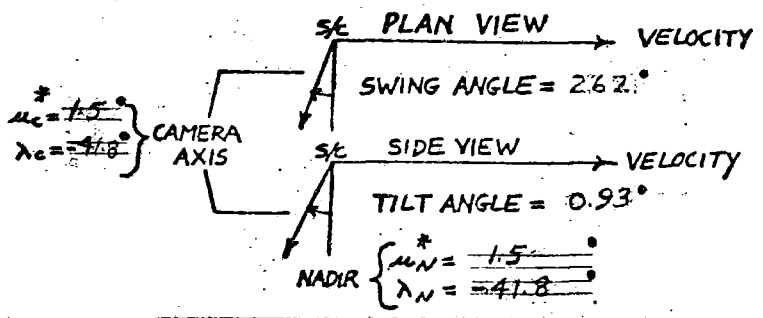
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.00540° .164 KM σ_λ=.00309° .0935 KM	σ_μ=.00554° .167 KM σ_λ=.00370° .112 KM	σ_μ=.00512° .155 KM σ_λ=.00319° .0965 KM	σ_μ=.00606° .184 KM σ_λ=.00312° .0945 KM	σ_μ=.00622° .188 KM σ_λ=.00311° .0941 KM	σ_μ=.00643° .195 KM σ_λ=.00323° .0979 KM	σ_μ=.00568° .172 KM σ_λ=.00313° .0948 KM	σ_μ=.00613° .126 KM σ_λ=.00351° .106 KM	σ_μ=.00587° .178 KM σ_λ=.00354° .107 KM
NAVIGATION	σ_μ=.00173 σ_λ=.00074	σ_μ=.00173 σ_λ=.00074	σ_μ=.00173 σ_λ=.00074	σ_μ=.00172 σ_λ=.00074	σ_μ=.00172 σ_λ=.00074	σ_μ=.00172 σ_λ=.00074	σ_μ=.00173 σ_λ=.00074	σ_μ=.00173 σ_λ=.00074	σ_μ=.00173 σ_λ=.00074
ATTITUDE	σ_μ=.00511 σ_λ=.00274	σ_μ=.00475 σ_λ=.00320	σ_μ=.00481 σ_λ=.00276	σ_μ=.00524 σ_λ=.00277	σ_μ=.00548 σ_λ=.00274	σ_μ=.00577 σ_λ=.00273	σ_μ=.00541 σ_λ=.00273	σ_μ=.00534 σ_λ=.00321	σ_μ=.00507 σ_λ=.00320
CAMERA ON-TIME	σ_μ=.00025 σ_λ=.00122	σ_μ=.00025 σ_λ=.00122	σ_μ=.00025 σ_λ=.00122	σ_μ=.00025 σ_λ=.00122	σ_μ=.00025 σ_λ=.00122	σ_μ=.00025 σ_λ=.00122	σ_μ=.00025 σ_λ=.00122	σ_μ=.00025 σ_λ=.00122	σ_μ=.00025 σ_λ=.00122
MOON RADIUS	σ_μ=.000001 σ_λ=.00011	σ_μ=.00225 σ_λ=.00119	σ_μ=.00009 σ_λ=.00075	σ_μ=.00249 σ_λ=.00021	σ_μ=.00238 σ_λ=.00033	σ_μ=.00225 σ_λ=.00098	σ_μ=.00009 σ_λ=.00053	σ_μ=.00249 σ_λ=.000001	σ_μ=.00238 σ_λ=.00054

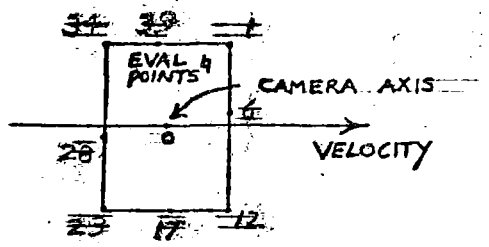
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.00630° .191 KM σ_λ=.00315° .0954 KM	σ_μ=.00606° .184 KM σ_λ=.00798° .242 KM	σ_μ=.00396° .120 KM σ_λ=.00587° .178 KM	σ_μ=.00861° .261 KM σ_λ=.00611° .185 KM	σ_μ=.00945° .286 KM σ_λ=.00391° .119 KM	σ_μ=.01108° .335 KM σ_λ=.00659° .200 KM	σ_μ=.00895° .268 KM σ_λ=.00571° .173 KM	σ_μ=.01142° .347 KM σ_λ=.00591° .179 KM	σ_μ=.00884° .268 KM σ_λ=.00506° .153 KM
NAVIGATION	σ_μ=.00173 σ_λ=.00074	σ_μ=.00174 σ_λ=.00074	σ_μ=.00173 σ_λ=.00074	σ_μ=.00172 σ_λ=.00074	σ_μ=.00172 σ_λ=.00074	σ_μ=.00172 σ_λ=.00075	σ_μ=.00173 σ_λ=.00075	σ_μ=.00175 σ_λ=.00075	σ_μ=.00175 σ_λ=.00074
ATTITUDE	σ_μ=.00606 σ_λ=.00281	σ_μ=.00370 σ_λ=.00528	σ_μ=.00352 σ_λ=.00312	σ_μ=.00555 σ_λ=.00475	σ_μ=.00751 σ_λ=.00359	σ_μ=.01000 σ_λ=.00326	σ_μ=.00866 σ_λ=.00319	σ_μ=.00934 σ_λ=.00466	σ_μ=.00672 σ_λ=.00479
CAMERA ON-TIME	σ_μ=.00025 σ_λ=.00122	σ_μ=.00025 σ_λ=.00123	σ_μ=.00025 σ_λ=.00122	σ_μ=.00026 σ_λ=.00122	σ_μ=.00026 σ_λ=.00122	σ_μ=.00025 σ_λ=.00122	σ_μ=.00025 σ_λ=.00122	σ_μ=.00025 σ_λ=.00122	σ_μ=.00025 σ_λ=.00122
MOON RADIUS	σ_μ=.000001 σ_λ=.00011	σ_μ=.00447 σ_λ=.00581	σ_μ=.00048 σ_λ=.00476	σ_μ=.00635 σ_λ=.00356	σ_μ=.00546 σ_λ=.00061	σ_μ=.00444 σ_λ=.00555	σ_μ=.00047 σ_λ=.00452	σ_μ=.00632 σ_λ=.00333	σ_μ=.00546 σ_λ=.00082

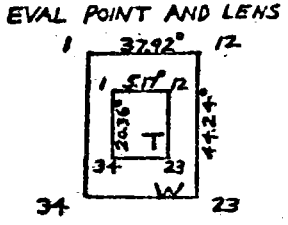
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION II FRAME 208





S/C ALTITUDE = 464 KM
TRUE ANOMALY = 5.7 °
INCLINATION ≈ 12 °
NOTE: APOLLO TGT. P=138



TELEPHOTO LENS, T

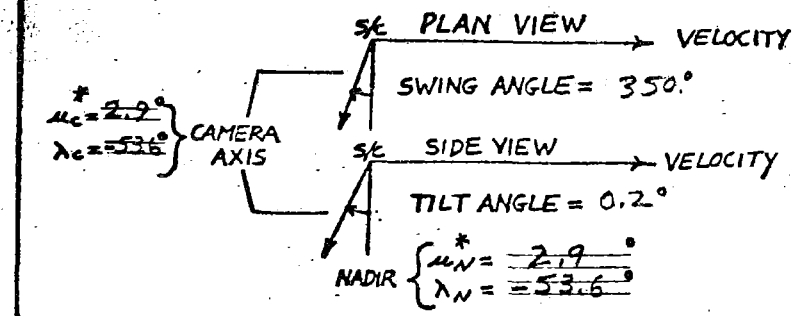
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.00564° .171 KM σ_λ=.00370° .114 KM	σ_μ=.00576° .175 KM σ_λ=.00426° .129 KM	σ_μ=.00536° .162 KM σ_λ=.00381° .115 KM	σ_μ=.00631° .191 KM σ_λ=.00371° .112 KM	σ_μ=.00647° .196 KM σ_λ=.00369° .112 KM	σ_μ=.00667° .202 KM σ_λ=.00378° .114 KM	σ_μ=.00592° .179 KM σ_λ=.00372° .113 KM	σ_μ=.00637° .193 KM σ_λ=.00406° .123 KM	σ_μ=.00609° .184 KM σ_λ=.00411° .125 KM
NAVIGATION	σ_μ=.00167 σ_λ=.00132	σ_μ=.00168 σ_λ=.00131	σ_μ=.00167 σ_λ=.00132	σ_μ=.00167 σ_λ=.00132	σ_μ=.00167 σ_λ=.00132	σ_μ=.00167 σ_λ=.00132	σ_μ=.00167 σ_λ=.00132	σ_μ=.00168 σ_λ=.00132	σ_μ=.00168 σ_λ=.00132
ATTITUDE	σ_μ=.00537 σ_λ=.00293	σ_μ=.00503 σ_λ=.00338	σ_μ=.00508 σ_λ=.00295	σ_μ=.00552 σ_λ=.00294	σ_μ=.00576 σ_λ=.00291	σ_μ=.00604 σ_λ=.00290	σ_μ=.00567 σ_λ=.00293	σ_μ=.00561 σ_λ=.00338	σ_μ=.00535 σ_λ=.00338
CAMERA ON-TIME	σ_μ=.00038 σ_λ=.00183	σ_μ=.00038 σ_λ=.00183	σ_μ=.00038 σ_λ=.00183	σ_μ=.00039 σ_λ=.00183	σ_μ=.00039 σ_λ=.00183	σ_μ=.00039 σ_λ=.00182	σ_μ=.00038 σ_λ=.00183	σ_μ=.00038 σ_λ=.00183	σ_μ=.00038 σ_λ=.00183
MOON RADIUS	σ_μ=.00002 σ_λ=.00019	σ_μ=.00222 σ_λ=.00128	σ_μ=.00007 σ_λ=.00083	σ_μ=.00252 σ_λ=.00029	σ_μ=.00241 σ_λ=.00025	σ_μ=.00227 σ_λ=.00090	σ_μ=.00011 σ_λ=.00045	σ_μ=.00247 σ_λ=.00088	σ_μ=.00236 σ_λ=.00063

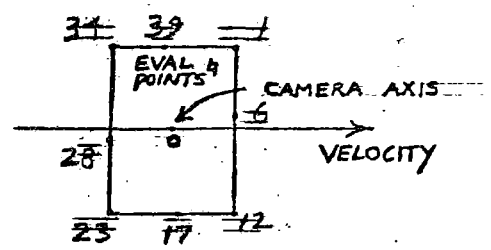
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.00660° .200 KM σ_λ=.00376° .114 KM	σ_μ=.00629° .190 KM σ_λ=.00838° .254 KM	σ_μ=.00427° .129 KM σ_λ=.00632° .191 KM	σ_μ=.00893° .270 KM σ_λ=.00648° .196 KM	σ_μ=.00976° .296 KM σ_λ=.00434° .131 KM	σ_μ=.01135° .344 KM σ_λ=.00683° .207 KM	σ_μ=.00910° .276 KM σ_λ=.00602° .182 KM	σ_μ=.01168° .354 KM σ_λ=.00619° .187 KM	σ_μ=.00910° .276 KM σ_λ=.00549° .166 KM
NAVIGATION	σ_μ=.00167 σ_λ=.00132	σ_μ=.00169 σ_λ=.00131	σ_μ=.00167 σ_λ=.00131	σ_μ=.00167 σ_λ=.00131	σ_μ=.00167 σ_λ=.00132	σ_μ=.00167 σ_λ=.00134	σ_μ=.00167 σ_λ=.00134	σ_μ=.00170 σ_λ=.00133	σ_μ=.00169 σ_λ=.00132
ATTITUDE	σ_μ=.00637 σ_λ=.00300	σ_μ=.00410 σ_λ=.00550	σ_μ=.00387 σ_λ=.00336	σ_μ=.00599 σ_λ=.00486	σ_μ=.00789 σ_λ=.00367	σ_μ=.00103 σ_λ=.00342	σ_μ=.00893 σ_λ=.00339	σ_μ=.00968 σ_λ=.00476	σ_μ=.00709 σ_λ=.00492
CAMERA ON-TIME	σ_μ=.00038 σ_λ=.00183	σ_μ=.00037 σ_λ=.00185	σ_μ=.00038 σ_λ=.00184	σ_μ=.00040 σ_λ=.00184	σ_μ=.00039 σ_λ=.00183	σ_μ=.00038 σ_λ=.00182	σ_μ=.00038 σ_λ=.00182	σ_μ=.00037 σ_λ=.00182	σ_μ=.00037 σ_λ=.00183
MOON RADIUS	σ_μ=.00002 σ_λ=.00019	σ_μ=.00445 σ_λ=.00591	σ_μ=.00051 σ_λ=.00485	σ_μ=.00640 σ_λ=.00364	σ_μ=.00549 σ_λ=.00054	σ_μ=.00445 σ_λ=.00547	σ_μ=.00445 σ_λ=.00443	σ_μ=.00629 σ_λ=.00324	σ_μ=.00544 σ_λ=.00091

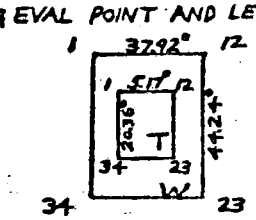
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION II FRAME 214





S/C ALTITUDE = 47.6 KM
TRUE ANOMALY = 355. °
INCLINATION = 12 °
NOTE:



TELEPHOTO LENS, T

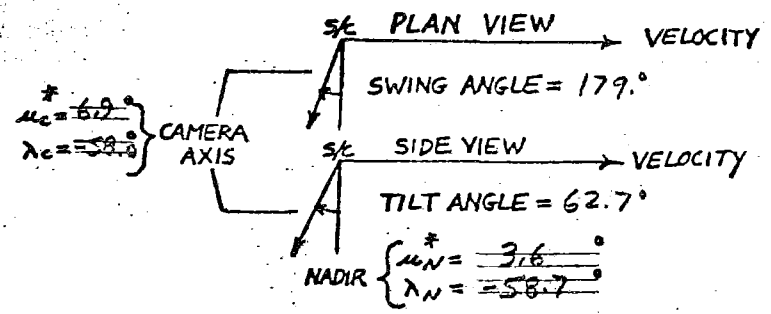
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00529° .160 KM σ_λ = .00401° .122 KM	σ_u = .00518° .157 KM σ_λ = .00471° .143 KM	σ_u = .00485° .147 KM σ_λ = .00407° .123 KM	σ_u = .00596° .181 KM σ_λ = .00420° .127 KM	σ_u = .00625° .189 KM σ_λ = .00419° .127 KM	σ_u = .00662° .201 KM σ_λ = .00428° .140 KM	σ_u = .00575° .174 KM σ_λ = .00407° .123 KM	σ_u = .00606° .183 KM σ_λ = .00464° .140 KM	σ_u = .00565° .171 KM σ_λ = .00463° .140 KM
NAVIGATION	σ_u = .00151 σ_λ = .00218	σ_u = .00151 σ_λ = .00218	σ_u = .00151 σ_λ = .00218	σ_u = .00151 σ_λ = .00218	σ_u = .00151 σ_λ = .00218	σ_u = .00151 σ_λ = .00219	σ_u = .00151 σ_λ = .00219	σ_u = .00151 σ_λ = .00218	σ_u = .00151 σ_λ = .00218
ATTITUDE	σ_u = .00506 σ_λ = .00283	σ_u = .00441 σ_λ = .00360	σ_u = .00459 σ_λ = .00285	σ_u = .00517 σ_λ = .00309	σ_u = .00555 σ_λ = .00304	σ_u = .00601 σ_λ = .00299	σ_u = .00553 σ_λ = .00282	σ_u = .00531 σ_λ = .00366	σ_u = .00490 σ_λ = .00363
CAMERA ON-TIME	σ_u = .00037 σ_λ = .00183	σ_u = .00037 σ_λ = .00183	σ_u = .00037 σ_λ = .00183	σ_u = .00036 σ_λ = .00183	σ_u = .00036 σ_λ = .00183	σ_u = .00036 σ_λ = .00183	σ_u = .00037 σ_λ = .00183	σ_u = .00037 σ_λ = .00183	σ_u = .00037 σ_λ = .00183
MOON RADIUS	σ_u = .00004 σ_λ = .00003	σ_u = .00221 σ_λ = .00105	σ_u = .00005 σ_λ = .00061	σ_u = .00259 σ_λ = .00008	σ_u = .00243 σ_λ = .00096	σ_u = .00229 σ_λ = .00112	σ_u = .00013 σ_λ = .00067	σ_u = .00295 σ_λ = .00014	σ_u = .00234 σ_λ = .00090

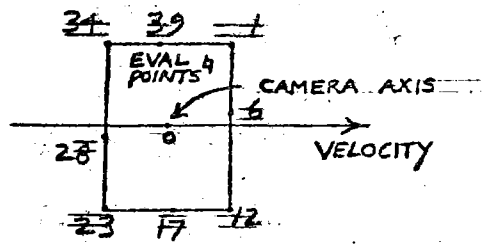
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00620° .188 KM σ_λ = .00406° .123 KM	σ_u = .00508° .154 KM σ_λ = .00901° .273 KM	σ_u = .00267° .111 KM σ_λ = .00629° .190 KM	σ_u = .00792° .240 KM σ_λ = .00786° .238 KM	σ_u = .00958° .290 KM σ_λ = .00579° .175 KM	σ_u = .01272° .385 KM σ_λ = .00757° .229 KM	σ_u = .01023° .310 KM σ_λ = .00644° .195 KM	σ_u = .01221° .370 KM σ_λ = .00782° .237 KM	σ_u = .00859° .259 KM σ_λ = .00693° .210 KM
NAVIGATION	σ_u = .00151 σ_λ = .00218	σ_u = .00152 σ_λ = .00217	σ_u = .00151 σ_λ = .00217	σ_u = .00152 σ_λ = .00217	σ_u = .00152 σ_λ = .00219	σ_u = .00152 σ_λ = .00222	σ_u = .00151 σ_λ = .00221	σ_u = .00152 σ_λ = .00220	σ_u = .00152 σ_λ = .00218
ATTITUDE	σ_u = .00660 σ_λ = .00290	σ_u = .00196 σ_λ = .00642	σ_u = .00211 σ_λ = .00320	σ_u = .00442 σ_λ = .00648	σ_u = .00767 σ_λ = .00498	σ_u = .01179 σ_λ = .00409	σ_u = .01010 σ_λ = .00335	σ_u = .01034 σ_λ = .00638	σ_u = .00640 σ_λ = .00629
CAMERA ON-TIME	σ_u = .00037 σ_λ = .00183	σ_u = .00037 σ_λ = .00182	σ_u = .00037 σ_λ = .00182	σ_u = .00036 σ_λ = .00182	σ_u = .00035 σ_λ = .00183	σ_u = .00035 σ_λ = .00185	σ_u = .00037 σ_λ = .00185	σ_u = .00039 σ_λ = .00185	σ_u = .00038 σ_λ = .00183
MOON RADIUS	σ_u = .00004 σ_λ = .00003	σ_u = .00442 σ_λ = .00564	σ_u = .00051 σ_λ = .00462	σ_u = .00639 σ_λ = .00344	σ_u = .00552 σ_λ = .00074	σ_u = .00453 σ_λ = .00572	σ_u = .00492 σ_λ = .00469	σ_u = .00629 σ_λ = .00351	σ_u = .00542 σ_λ = .00067

* u = LATITUDE λ = LONGITUDE

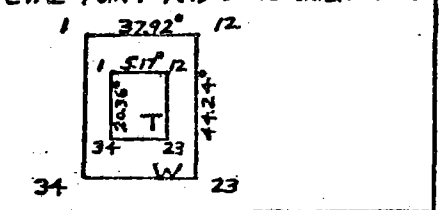
ERROR ANALYSIS RESULTS MISSION II FRAME 215





S/C ALTITUDE = 50.6 KM
TRUE ANOMALY = 352.°
INCLINATION ≈ 12.°
NOTE:

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

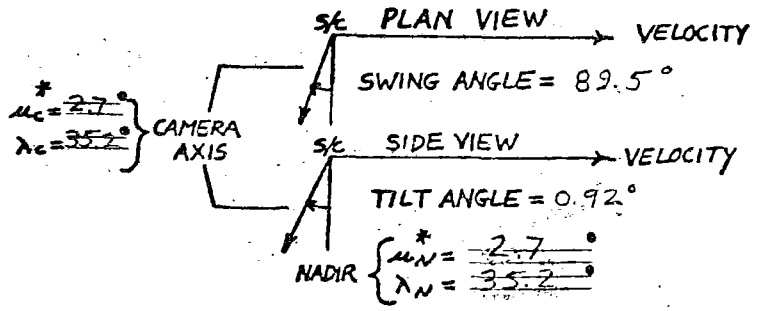
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.04339° 1.32 KM σ_λ=.01183° .357 KM	σ_u=.14014° 4.25 KM σ_λ=.04391° 1.33 KM	σ_u=.04426° 1.34 KM σ_λ=.01402° .425 KM	σ_u=.02402° .728 KM σ_λ=.00816° .247 KM	σ_u=.02481° .753 KM σ_λ=.00759° .230 KM	σ_u=.02599° .785 KM σ_λ=.00705° .214 KM	σ_u=.04264° 1.29 KM σ_λ=.01002° 3.03 KM	σ_u=.16019° 4.85 KM σ_λ=.03444° 1.04 KM	σ_u=.15046° 4.55 KM σ_λ=.03894° 1.18 KM
NAVIGATION	σ_u=.00178 σ_λ=.00306	σ_u=.00265 σ_λ=.00303	σ_u=.00180 σ_λ=.00306	σ_u=.00164 σ_λ=.00307	σ_u=.00164 σ_λ=.00307	σ_u=.00164 σ_λ=.00308	σ_u=.00177 σ_λ=.00307	σ_u=.00275 σ_λ=.00303	σ_u=.00270 σ_λ=.00303
ATTITUDE	σ_u=.03247 σ_λ=.00952	σ_u=.12423 σ_λ=.04020	σ_u=.03262 σ_λ=.01101	σ_u=.01593 σ_λ=.00558	σ_u=.01696 σ_λ=.00549	σ_u=.01823 σ_λ=.00543	σ_u=.03237 σ_λ=.00829	σ_u=.14557 σ_λ=.03237	σ_u=.13529 σ_λ=.03617
CAMERA ON-TIME	σ_u=.00050 σ_λ=.00181	σ_u=.00063 σ_λ=.00178	σ_u=.00049 σ_λ=.00181	σ_u=.00044 σ_λ=.00181	σ_u=.00045 σ_λ=.00182	σ_u=.00045 σ_λ=.00182	σ_u=.00050 σ_λ=.00182	σ_u=.00074 σ_λ=.00179	σ_u=.00061 σ_λ=.00178
MOON RADIUS	σ_u=.02873 σ_λ=.00607	σ_u=.06479 σ_λ=.01733	σ_u=.02985 σ_λ=.00792	σ_u=.01789 σ_λ=.00477	σ_u=.01810 σ_λ=.00384	σ_u=.01837 σ_λ=.00273	σ_u=.02772 σ_λ=.00436	σ_u=.06679 σ_λ=.01121	σ_u=.06578 σ_λ=.01399

WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.04754° 1.44 KM σ_λ=.01239° .375 KM	σ_u= ° KM σ_λ= ° KM ND	σ_u=.03762° 1.14 KM σ_λ=.02580° .782 KM	σ_u=.01314° .397 KM σ_λ=.01056° .321 KM	σ_u=.01696° .515 KM σ_λ=.00693° .211 KM	σ_u=.02303° .698 KM σ_λ=.00917° .278 KM	σ_u=.06127° 1.86 KM σ_λ=.01211° .366 KM	σ_u= ° KM σ_λ= ° KM ND	σ_u= ° KM σ_λ= ° KM ND
NAVIGATION	σ_u=.00178 σ_λ=.00306	σ_u= σ_λ= ND	σ_u=.00179 σ_λ=.00309	σ_u=.00158 σ_λ=.00305	σ_u=.00158 σ_λ=.00307	σ_u=.00159 σ_λ=.00313	σ_u=.00180 σ_λ=.00317	σ_u= σ_λ= ND	σ_u= σ_λ= ND
ATTITUDE	σ_u=.03783 σ_λ=.01019	σ_u= σ_λ= ND	σ_u=.02296 σ_λ=.01671	σ_u=.00793 σ_λ=.00591	σ_u=.01238 σ_λ=.00522	σ_u=.01898 σ_λ=.00771	σ_u=.05398 σ_λ=.01041	σ_u= σ_λ= ND	σ_u= σ_λ= ND
CAMERA ON-TIME	σ_u=.00050 σ_λ=.00181	σ_u= σ_λ= ND	σ_u=.00040 σ_λ=.00182	σ_u=.00039 σ_λ=.00181	σ_u=.00041 σ_λ=.00182	σ_u=.00044 σ_λ=.00185	σ_u=.00058 σ_λ=.00188	σ_u= σ_λ= ND	σ_u= σ_λ= ND
MOON RADIUS	σ_u=.02873 σ_λ=.00607	σ_u= σ_λ=	σ_u=.02936 σ_λ=.01932	σ_u=.01035 σ_λ=.00799	σ_u=.01148 σ_λ=.00282	σ_u=.01295 σ_λ=.00339	σ_u=.02892 σ_λ=.00498	σ_u= σ_λ=	σ_u= σ_λ=

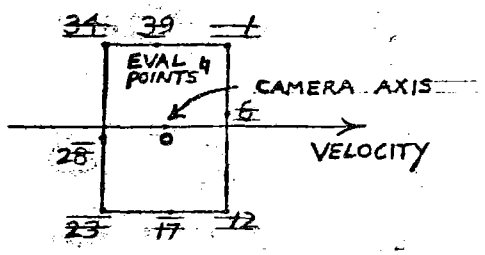
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION III FRAME 12



$\mu_c^* = 27°$, $\lambda_c = 352°$

$\mu_N^* = 2.7°$, $\lambda_N = 352°$



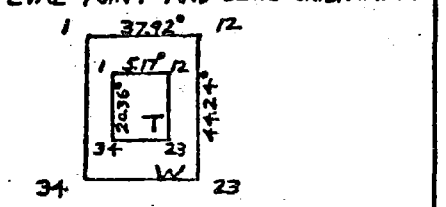
S/C ALTITUDE = 547 KM

TRUE ANOMALY = 353°

INCLINATION ≈ 21°

NOTE: APOLLO TGT III P-1

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

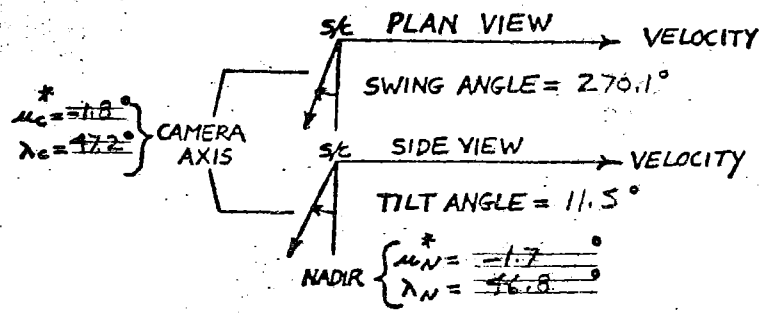
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .00628° .190 KM; σ_λ = .00386° .117 KM	σ_μ = .00585° .177 KM; σ_λ = .00476° .144 KM	σ_μ = .00583° .177 KM; σ_λ = .00387° .117 KM	σ_μ = .00712° .216 KM; σ_λ = .00375° .114 KM	σ_μ = .00737° .223 KM; σ_λ = .00384° .116 KM	σ_μ = .00770° .234 KM; σ_λ = .00407° .123 KM	σ_μ = .00673° .204 KM; σ_λ = .00398° .118 KM	σ_μ = .00680° .206 KM; σ_λ = .00475° .144 KM	σ_μ = .00636° .192 KM; σ_λ = .00472° .143 KM
NAVIGATION	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0
ATTITUDE	σ_μ = .00624; σ_λ = .00344	σ_μ = .00541; σ_λ = .00428	σ_μ = .00579; σ_λ = .00344	σ_μ = .00665; σ_λ = .00327	σ_μ = .00699; σ_λ = .00325	σ_μ = .00741; σ_λ = .00326	σ_μ = .00670; σ_λ = .00396	σ_μ = .00627; σ_λ = .00443	σ_μ = .00587; σ_λ = .00435
CAMERA ON-TIME	σ_μ = .00066; σ_λ = .00174	σ_μ = .00067; σ_λ = .00173	σ_μ = .00066; σ_λ = .00173	σ_μ = .00065; σ_λ = .00174	σ_μ = .00065; σ_λ = .00174	σ_μ = .00065; σ_λ = .00175	σ_μ = .00066; σ_λ = .00174	σ_μ = .00067; σ_λ = .00174	σ_μ = .00067; σ_λ = .00174
MOON RADIUS	σ_μ = .00006; σ_λ = .00028	σ_μ = .00211; σ_λ = .00115	σ_μ = .00004; σ_λ = .00037	σ_μ = .00243; σ_λ = .00056	σ_μ = .00224; σ_λ = .00108	σ_μ = .00201; σ_λ = .00171	σ_μ = .00007; σ_λ = .00093	σ_μ = .00285; σ_λ = .00001	σ_μ = .00238; σ_λ = .00053

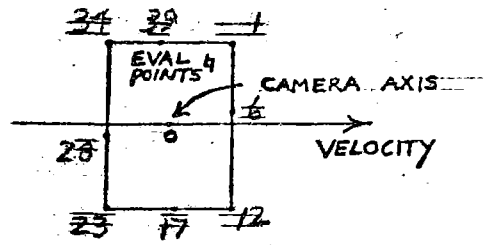
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .00730° .221 KM; σ_λ = .00398° .121 KM	σ_μ = .00466° .141 KM; σ_λ = .00917° .277 KM	σ_μ = .00397° .120 KM; σ_λ = .00586° .177 KM	σ_μ = .00988° .296 KM; σ_λ = .00661° .201 KM	σ_μ = .01108° .336 KM; σ_λ = .00496° .150 KM	σ_μ = .01374° .415 KM; σ_λ = .00797° .241 KM	σ_μ = .01122° .340 KM; σ_λ = .00681° .206 KM	σ_μ = .01315° .398 KM; σ_λ = .00819° .248 KM	σ_μ = .00899° .272 KM; σ_λ = .00736° .223 KM
NAVIGATION	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0
ATTITUDE	σ_μ = .00727; σ_λ = .00357	σ_μ = .00293; σ_λ = .00670	σ_μ = .00374; σ_λ = .00367	σ_μ = .00709; σ_λ = .00601	σ_μ = .00973; σ_λ = .00427	σ_μ = .01327; σ_λ = .00396	σ_μ = .01113; σ_λ = .00442	σ_μ = .01115; σ_λ = .00751	σ_μ = .00717; σ_λ = .00709
CAMERA ON-TIME	σ_μ = .00066; σ_λ = .00174	σ_μ = .00067; σ_λ = .00172	σ_μ = .00066; σ_λ = .00173	σ_μ = .00064; σ_λ = .00173	σ_μ = .00064; σ_λ = .00175	σ_μ = .00064; σ_λ = .00178	σ_μ = .00067; σ_λ = .00177	σ_μ = .00070; σ_λ = .00176	σ_μ = .00069; σ_λ = .00173
MOON RADIUS	σ_μ = .00006; σ_λ = .00028	σ_μ = .00356; σ_λ = .00602	σ_μ = .00113; σ_λ = .00423	σ_μ = .00674; σ_λ = .00214	σ_μ = .00526; σ_λ = .00184	σ_μ = .00352; σ_λ = .00668	σ_μ = .00126; σ_λ = .00486	σ_μ = .00694; σ_λ = .00273	σ_μ = .00537; σ_λ = .00129

* μ = LATITUDE λ = LONGITUDE

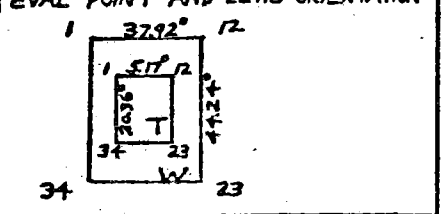
ERROR ANALYSIS RESULTS MISSION III FRAME 22





S/C ALTITUDE = 52.9 KM
TRUE ANOMALY = 5.1 °
INCLINATION = 21. °
NOTE:

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

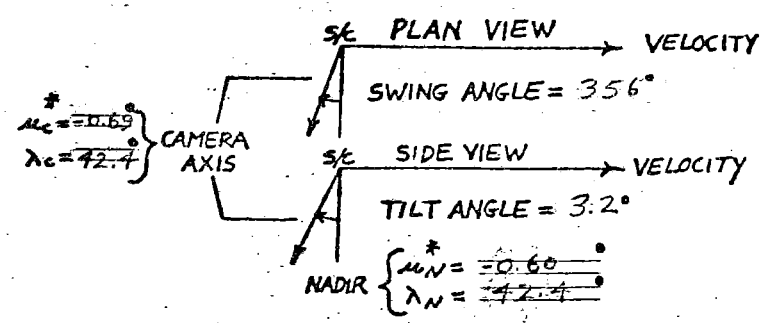
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .00623° .189 KM; σ_λ = .00460° .139 KM	σ_μ = .00548° .166 KM; σ_λ = .00620° .188 KM	σ_μ = .00586° .178 KM; σ_λ = .00506° .153 KM	σ_μ = .00767° .232 KM; σ_λ = .00436° .132 KM	σ_μ = .00779° .236 KM; σ_λ = .00404° .122 KM	σ_μ = .00796° .241 KM; σ_λ = .00375° .114 KM	σ_μ = .00661° .200 KM; σ_λ = .00424° .129 KM	σ_μ = .00627° .190 KM; σ_λ = .00549° .166 KM	σ_μ = .00591° .179 KM; σ_λ = .00578° .175 KM
NAVIGATION	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0
ATTITUDE	σ_μ = .00611; σ_λ = .00344	σ_μ = .00533; σ_λ = .00440	σ_μ = .005731; σ_λ = .00351	σ_μ = .00675; σ_λ = .00331	σ_μ = .00700; σ_λ = .00323	σ_μ = .00731; σ_λ = .00316	σ_μ = .00650; σ_λ = .00339	σ_μ = .00605; σ_λ = .00439	σ_μ = .00572; σ_λ = .00439
CAMERA ON-TIME	σ_μ = .00067; σ_λ = .00175	σ_μ = .00066; σ_λ = .00175	σ_μ = .00067; σ_λ = .00175	σ_μ = .00068; σ_λ = .00175	σ_μ = .00068; σ_λ = .00175	σ_μ = .00068; σ_λ = .00174	σ_μ = .00067; σ_λ = .00175	σ_μ = .00066; σ_λ = .00175	σ_μ = .00066; σ_λ = .00175
MOON RADIUS	σ_μ = .00101; σ_λ = .00251	σ_μ = .00111; σ_λ = .00400	σ_μ = .00102; σ_λ = .00319	σ_μ = .00358; σ_λ = .00223	σ_μ = .00335; σ_λ = .00168	σ_μ = .00308; σ_λ = .00105	σ_μ = .00099; σ_λ = .00184	σ_μ = .00151; σ_λ = .00279	σ_μ = .00133; σ_λ = .00333

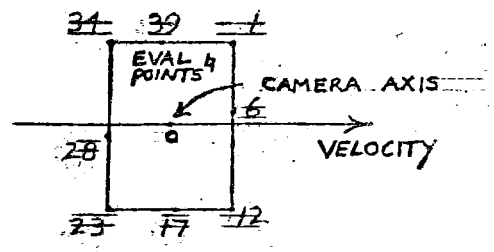
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .00722° .219 KM; σ_λ = .00470° .142 KM	σ_μ = .00431° .131 KM; σ_λ = .0126° .382 KM	σ_μ = .00472° .143 KM; σ_λ = .00895° .271 KM	σ_μ = .0122° .370 KM; σ_λ = .00897° .272 KM	σ_μ = .0121° .367 KM; σ_λ = .00463° .140 KM	σ_μ = .0131° .397 KM; σ_λ = .00519° .157 KM	σ_μ = .0101° .306 KM; σ_λ = .00470° .142 KM	σ_μ = .0116° .352 KM; σ_λ = .00704° .213 KM	σ_μ = .00839° .254 KM; σ_λ = .00839° .254 KM
NAVIGATION	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0
ATTITUDE	σ_μ = .00711; σ_λ = .00357	σ_μ = .00319; σ_λ = .00801	σ_μ = .00402; σ_λ = .00435	σ_μ = .00862; σ_λ = .00701	σ_μ = .0102; σ_λ = .00420	σ_μ = .0124; σ_λ = .00330	σ_μ = .0101; σ_λ = .00394	σ_μ = .0102; σ_λ = .00682	σ_μ = .00714; σ_λ = .00710
CAMERA ON-TIME	σ_μ = .00067; σ_λ = .00175	σ_μ = .00065; σ_λ = .00179	σ_μ = .00068; σ_λ = .00178	σ_μ = .00071; σ_λ = .00177	σ_μ = .00069; σ_λ = .00174	σ_μ = .00068; σ_λ = .00173	σ_μ = .00066; σ_λ = .00173	σ_μ = .00065; σ_λ = .00174	σ_μ = .00065; σ_λ = .00175
MOON RADIUS	σ_μ = .00101; σ_λ = .00251	σ_μ = .00282; σ_λ = .00961	σ_μ = .00238; σ_λ = .00761	σ_μ = .00861; σ_λ = .00532	σ_μ = .00648; σ_λ = .00091	σ_μ = .00433; σ_λ = .00361	σ_μ = .00017; σ_λ = .00189	σ_μ = .00552; σ_λ = .00014	σ_μ = .00437; σ_λ = .00410

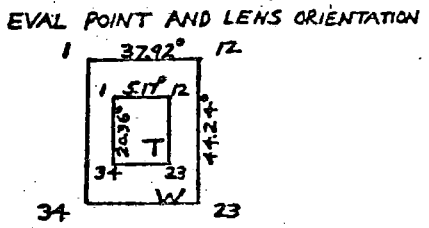
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION III FRAME 28





S/C ALTITUDE = 51.1 KM
TRUE ANOMALY = 2.4 °
INCLINATION = -21 °
NOTE: Apollo 16 T III P-2A



TELEPHOTO LENS, T

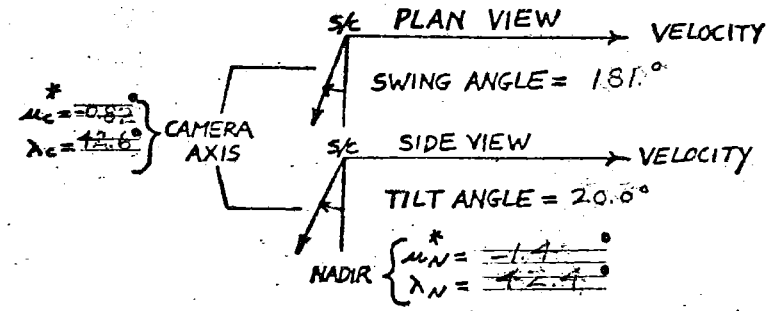
ERROR SOURCE	CAMERA AXIS (0)		EVAL POINT 1		EVAL POINT 6		EVAL POINT 12		EVAL POINT 17		EVAL POINT 23		EVAL POINT 28		EVAL POINT 34		EVAL POINT 39	
TOTAL	σ_μ = .00620° .188 KM	σ_λ = .00435° .129 KM	σ_μ = .00592° .179 KM	σ_λ = .00461° .140 KM	σ_μ = .00601° .182 KM	σ_λ = .00425° .129 KM	σ_μ = .00732° .222 KM	σ_λ = .00516° .126 KM	σ_μ = .00735° .222 KM	σ_λ = .00429° .130 KM	σ_μ = .00739° .224 KM	σ_λ = .00452° .137 KM	σ_μ = .00639° .193 KM	σ_λ = .00435° .132 KM	σ_μ = .00631° .193 KM	σ_λ = .00450° .136 KM	σ_μ = .00617° .187 KM	σ_λ = .00497° .137 KM
NAVIGATION	σ_μ = .00223°	σ_λ = .00235°	σ_μ = .00224°	σ_λ = .00234°	σ_μ = .00223°	σ_λ = .00235°	σ_μ = .00225°	σ_λ = .00235°	σ_μ = .00225°	σ_λ = .00235°	σ_μ = .00223°	σ_λ = .00236°	σ_μ = .00225°	σ_λ = .00235°	σ_μ = .00223°	σ_λ = .00235°	σ_μ = .00223°	σ_λ = .00235°
ATTITUDE	σ_μ = .00563°	σ_λ = .00306°	σ_μ = .00529°	σ_λ = .00339°	σ_μ = .00549°	σ_λ = .00306°	σ_μ = .00612°	σ_λ = .00290°	σ_μ = .00625°	σ_λ = .00292°	σ_μ = .00642°	σ_λ = .00296°	σ_μ = .00591°	σ_λ = .00308°	σ_μ = .00568°	σ_λ = .00342°	σ_μ = .00550°	σ_λ = .00340°
CAMERA ON-TIME	σ_μ = .00066°	σ_λ = .00174°	σ_μ = .00066°	σ_λ = .00174°	σ_μ = .00066°	σ_λ = .00174°	σ_μ = .00067°	σ_λ = .00174°	σ_μ = .00067°	σ_λ = .00174°	σ_μ = .00066°	σ_λ = .00174°	σ_μ = .00066°	σ_λ = .00174°	σ_μ = .00066°	σ_λ = .00174°	σ_μ = .00066°	σ_λ = .00174°
MOON RADIUS	σ_μ = .00075°	σ_λ = .00030°	σ_μ = .00129°	σ_λ = .00112°	σ_μ = .00076°	σ_λ = .00035°	σ_μ = .00327°	σ_λ = .00060°	σ_μ = .00307°	σ_λ = .00113°	σ_μ = .00293°	σ_λ = .00176°	σ_μ = .00073°	σ_λ = .00035°	σ_μ = .00172°	σ_λ = .00061°	σ_μ = .00152°	σ_λ = .00051°

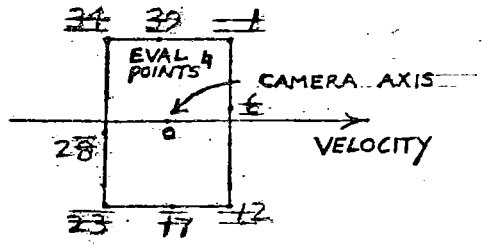
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS		EVAL POINT 1		EVAL POINT 6		EVAL POINT 12		EVAL POINT 17		EVAL POINT 23		EVAL POINT 28		EVAL POINT 34		EVAL POINT 39	
TOTAL	σ_μ = .0070° .214 KM	σ_λ = .0044° .131 KM	σ_μ = .0059° .179 KM	σ_λ = .0083° .248 KM	σ_μ = .0059° .179 KM	σ_λ = .0062° .186 KM	σ_μ = .0113° .343 KM	σ_λ = .0052° .158 KM	σ_μ = .0110° .334 KM	σ_λ = .0046° .140 KM	σ_μ = .0112° .340 KM	σ_λ = .0083° .254 KM	σ_μ = .0085° .262 KM	σ_λ = .0068° .207 KM	σ_μ = .0108° .327 KM	σ_λ = .0060° .183 KM	σ_μ = .0084° .256 KM	σ_λ = .0055° .168 KM
NAVIGATION	σ_μ = .00223°	σ_λ = .00235°	σ_μ = .00224°	σ_λ = .00233°	σ_μ = .00223°	σ_λ = .00233°	σ_μ = .00224°	σ_λ = .00234°	σ_μ = .00224°	σ_λ = .00236°	σ_μ = .00223°	σ_λ = .00240°	σ_μ = .00224°	σ_λ = .00236°	σ_μ = .00226°	σ_λ = .00237°	σ_μ = .00225°	σ_λ = .00234°
ATTITUDE	σ_μ = .00663°	σ_λ = .00319°	σ_μ = .00472°	σ_λ = .00485°	σ_μ = .00506°	σ_λ = .00335°	σ_μ = .00785°	σ_λ = .00376°	σ_μ = .00872°	σ_λ = .00301°	σ_μ = .0100°	σ_λ = .00391°	σ_μ = .00832°	σ_λ = .00380°	σ_μ = .00871°	σ_λ = .00457°	σ_μ = .00680°	σ_λ = .00453°
CAMERA ON-TIME	σ_μ = .00066°	σ_λ = .00174°	σ_μ = .00065°	σ_λ = .00176°	σ_μ = .00067°	σ_λ = .00175°	σ_μ = .00068°	σ_λ = .00175°	σ_μ = .00067°	σ_λ = .00174°	σ_μ = .00066°	σ_λ = .00174°	σ_μ = .00066°	σ_λ = .00174°	σ_μ = .00066°	σ_λ = .00174°	σ_μ = .00066°	σ_λ = .00174°
MOON RADIUS	σ_μ = .00075°	σ_λ = .00030°	σ_μ = .00268°	σ_λ = .00589°	σ_μ = .00196°	σ_λ = .00422°	σ_μ = .00779°	σ_λ = .00216°	σ_μ = .00621°	σ_λ = .00193°	σ_μ = .00457°	σ_λ = .00683°	σ_μ = .00047°	σ_λ = .00484°	σ_μ = .00593°	σ_λ = .00264°	σ_μ = .00444°	σ_λ = .00125°

* μ = LATITUDE λ = LONGITUDE

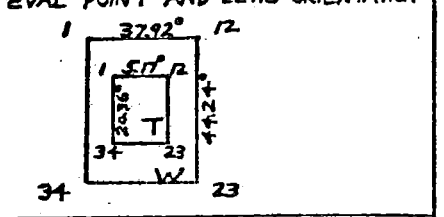
ERROR ANALYSIS RESULTS MISSION III FRAME 34





S/C ALTITUDE = 517 KM
TRUE ANOMALY = 4.4°
INCLINATION ≈ 21°
NOTE: APOLLO TGT JTP - 2.B.

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

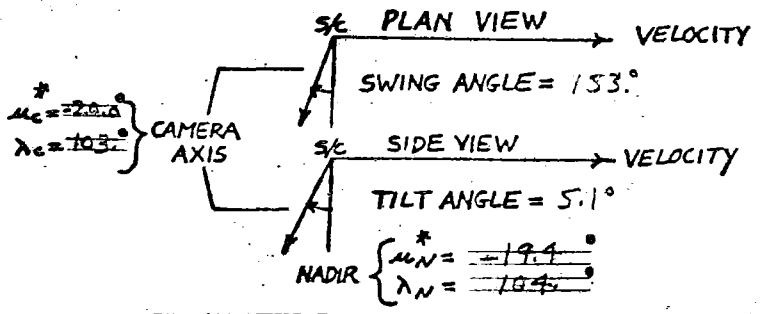
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .00811° .246 KM; σ_λ = .00408° .127 KM	σ_μ = .00988° .299 KM; σ_λ = .00583° .176 KM	σ_μ = .00782° .238 KM; σ_λ = .00447° .1409 KM	σ_μ = .00657° .199 KM; σ_λ = .00373° .113 KM	σ_μ = .00690° .208 KM; σ_λ = .00355° .107 KM	σ_μ = .00731° .221 KM; σ_λ = .00344° .104 KM	σ_μ = .00842° .258 KM; σ_λ = .00379° .1149 KM	σ_μ = .01093° .330 KM; σ_λ = .00514° .155 KM	σ_μ = .01044° .315 KM; σ_λ = .00543° .1645 KM
NAVIGATION	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0
ATTITUDE	σ_μ = .00670; σ_λ = .00323	σ_μ = .00685; σ_λ = .00324	σ_μ = .00633; σ_λ = .00329	σ_μ = .00626; σ_λ = .00296	σ_μ = .00655; σ_λ = .00295	σ_μ = .00690; σ_λ = .00295	σ_μ = .00709; σ_λ = .00319	σ_μ = .00735; σ_λ = .00332	σ_μ = .00739; σ_λ = .00433
CAMERA ON-TIME	σ_μ = .000649; σ_λ = .00174	σ_μ = .000641; σ_λ = .00175	σ_μ = .000649; σ_λ = .00175	σ_μ = .000657; σ_λ = .00174	σ_μ = .000659; σ_λ = .00174	σ_μ = .000658; σ_λ = .00174	σ_μ = .000651; σ_λ = .00174	σ_μ = .000643; σ_λ = .00174	σ_μ = .000643; σ_λ = .00174
MOON RADIUS	σ_μ = .00454; σ_λ = .00178	σ_μ = .00709; σ_λ = .00278	σ_μ = .00455; σ_λ = .00248	σ_μ = .00190; σ_λ = .00145	σ_μ = .00209; σ_λ = .000726	σ_μ = .00232; σ_λ = .000303	σ_μ = .00453; σ_λ = .00109	σ_μ = .00758; σ_λ = .00217	σ_μ = .00736; σ_λ = .00277

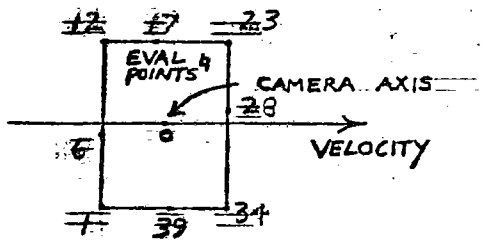
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .00906° .274 KM; σ_λ = .00416° .126 KM	σ_μ = .01103° .334 KM; σ_λ = .01309° .396 KM	σ_μ = .00563° .170 KM; σ_λ = .00786° .237 KM	σ_μ = .00647° .196 KM; σ_λ = .00641° .194 KM	σ_μ = .00794° .240 KM; σ_λ = .00402° .127 KM	σ_μ = .01059° .320 KM; σ_λ = .00577° .175 KM	σ_μ = .01285° .390 KM; σ_λ = .00495° .148 KM	σ_μ = .02212° .670 KM; σ_λ = .00709° .214 KM	σ_μ = .01644° .498 KM; σ_λ = .00893° .271 KM
NAVIGATION	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0	σ_μ = 0; σ_λ = 0
ATTITUDE	σ_μ = .00780; σ_λ = .00333	σ_μ = .00542; σ_λ = .00823	σ_μ = .00450; σ_λ = .00368	σ_μ = .00610; σ_λ = .00475	σ_μ = .00788; σ_λ = .00362	σ_μ = .01063; σ_λ = .00360	σ_μ = .01147; σ_λ = .00354	σ_μ = .01236; σ_λ = .00478	σ_μ = .01147; σ_λ = .00983
CAMERA ON-TIME	σ_μ = .000650; σ_λ = .00174	σ_μ = .000618; σ_λ = .00178	σ_μ = .000648; σ_λ = .00177	σ_μ = .000670; σ_λ = .00176	σ_μ = .000664; σ_λ = .00174	σ_μ = .000661; σ_λ = .00173	σ_μ = .000656; σ_λ = .00174	σ_μ = .000650; σ_λ = .00174	σ_μ = .000632; σ_λ = .00175
MOON RADIUS	σ_μ = .00454; σ_λ = .00178	σ_μ = .00959; σ_λ = .01003	σ_μ = .00332; σ_λ = .00671	σ_μ = .00206; σ_λ = .00393	σ_μ = .000677; σ_λ = .000232	σ_μ = .000964; σ_λ = .00416	σ_μ = .00596; σ_λ = .00298	σ_μ = .01369; σ_λ = .00111	σ_μ = .01176; σ_λ = .0393

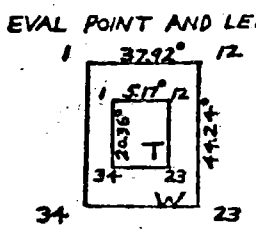
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION III FRAME 37





S/C ALTITUDE = 393. KM
TRUE ANOMALY = 69. °
INCLINATION ≈ 21. °
NOTE: R(90°) Y(0°) P(0°)



TELEPHOTO LENS, T

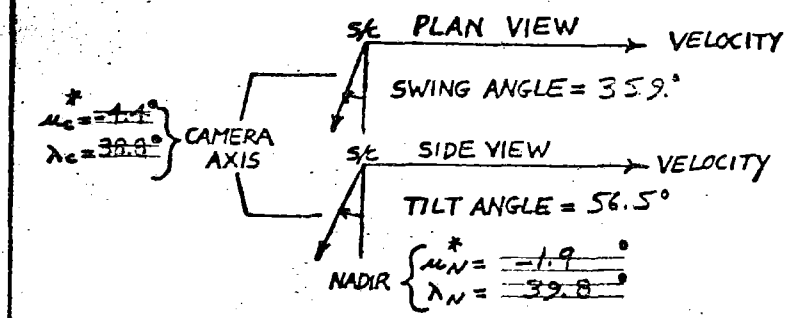
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.0367° 1.11 KM; σ_λ=.1240° 3.76 KM	σ_u=.0360° 1.09 KM; σ_λ=.1345° 4.08 KM	σ_u=.0342° 1.10 KM; σ_λ=.1235° 3.74 KM	σ_u=.0383° 1.16 KM; σ_λ=.1227° 3.72 KM	σ_u=.0381° 1.15 KM; σ_λ=.1238° 3.75 KM	σ_u=.0390° 1.16 KM; σ_λ=.1252° 3.80 KM	σ_u=.0373° 1.13 KM; σ_λ=.1247° 3.78 KM	σ_u=.0381° 1.16 KM; σ_λ=.1367° 4.14 KM	σ_u=.0370° 1.12 KM; σ_λ=.1356° 4.11 KM
NAVIGATION	σ_u=.00725; σ_λ=.00249	σ_u=.00725; σ_λ=.00242	σ_u=.00726; σ_λ=.00247	σ_u=.00726; σ_λ=.00238	σ_u=.00725; σ_λ=.00259	σ_u=.00725; σ_λ=.00261	σ_u=.00726; σ_λ=.00251	σ_u=.00727; σ_λ=.00244	σ_u=.00726; σ_λ=.00243
ATTITUDE	σ_u=.0359; σ_λ=.1240	σ_u=.0353; σ_λ=.1344	σ_u=.0355; σ_λ=.1235	σ_u=.0376; σ_λ=.1226	σ_u=.0374; σ_λ=.1237	σ_u=.0373; σ_λ=.1251	σ_u=.0365; σ_λ=.1247	σ_u=.0373; σ_λ=.1366	σ_u=.0363; σ_λ=.1355
CAMERA ON-TIME	σ_u=.00025; σ_λ=.00162	σ_u=.00026; σ_λ=.00155	σ_u=.00023; σ_λ=.00160	σ_u=.00019; σ_λ=.00169	σ_u=.00021; σ_λ=.00170	σ_u=.00024; σ_λ=.00171	σ_u=.00026; σ_λ=.00163	σ_u=.00029; σ_λ=.00156	σ_u=.00028; σ_λ=.00155
MOON RADIUS	σ_u=.00091; σ_λ=.00115	σ_u=.00057; σ_λ=.00443	σ_u=.00022; σ_λ=.00153	σ_u=.00027; σ_λ=.00175	σ_u=.00037; σ_λ=.00187	σ_u=.00115; σ_λ=.00203	σ_u=.00159; σ_λ=.00075	σ_u=.00207; σ_λ=.00427	σ_u=.00139; σ_λ=.00434

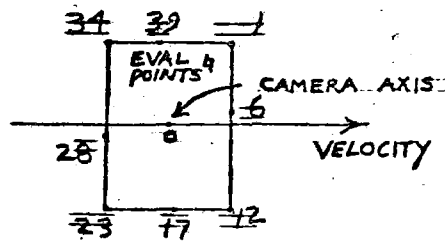
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.0384° 1.16 KM; σ_λ=.1439° 4.35 KM	σ_u=.0431° 1.31 KM; σ_λ=.1939° 5.87 KM	σ_u=.0388° 1.18 KM; σ_λ=.1389° 4.20 KM	σ_u=.0613° 1.86 KM; σ_λ=.1502° 4.65 KM	σ_u=.0467° 1.41 KM; σ_λ=.1597° 4.84 KM	σ_u=.0422° 1.28 KM; σ_λ=.1810° 5.48 KM	σ_u=.0474° 1.44 KM; σ_λ=.1564° 4.74 KM	σ_u=.0731° 2.22 KM; σ_λ=.2191° 6.64 KM	σ_u=.0424° 1.28 KM; σ_λ=.2002° 6.07 KM
NAVIGATION	σ_u=.00725; σ_λ=.00249	σ_u=.00742; σ_λ=.00236	σ_u=.00745; σ_λ=.00240	σ_u=.00754; σ_λ=.00265	σ_u=.00727; σ_λ=.00276	σ_u=.00740; σ_λ=.00300	σ_u=.00749; σ_λ=.00263	σ_u=.00784; σ_λ=.00258	σ_u=.00727; σ_λ=.00244
ATTITUDE	σ_u=.0378; σ_λ=.1439	σ_u=.0422; σ_λ=.1937	σ_u=.0378; σ_λ=.1389	σ_u=.0605; σ_λ=.1501	σ_u=.0462; σ_λ=.1596	σ_u=.0412; σ_λ=.1808	σ_u=.0463; σ_λ=.1563	σ_u=.0722; σ_λ=.2189	σ_u=.0417; σ_λ=.2000
CAMERA ON-TIME	σ_u=.00025; σ_λ=.00162	σ_u=.00022; σ_λ=.00148	σ_u=.00013; σ_λ=.00155	σ_u=0; σ_λ=.00175	σ_u=.00015; σ_λ=.00183	σ_u=.00037; σ_λ=.00198	σ_u=.00041; σ_λ=.00172	σ_u=.00043; σ_λ=.00154	σ_u=.00032; σ_λ=.00151
MOON RADIUS	σ_u=.00091; σ_λ=.00115	σ_u=.00430; σ_λ=.00956	σ_u=.00458; σ_λ=.00259	σ_u=.00568; σ_λ=.00458	σ_u=.00072; σ_λ=.00558	σ_u=.00542; σ_λ=.00744	σ_u=.00664; σ_λ=.00045	σ_u=.00837; σ_λ=.00912	σ_u=.00232; σ_λ=.00895

* μ = LATITUDE λ = LONGITUDE

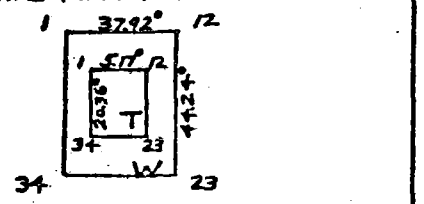
ERROR ANALYSIS RESULTS MISSION III FRAME 38





S/C ALTITUDE = 51.8 KM
TRUE ANOMALY = 5.6°
INCLINATION ≈ 21°
NOTE:

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

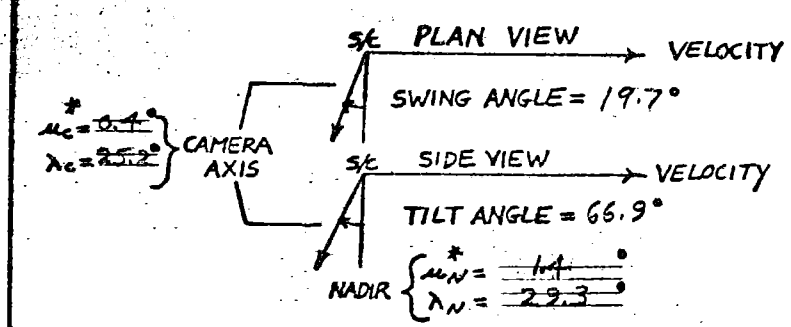
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.0276° .835 KM σ_λ=.0138° .418 KM	σ_u=.0182° .551 KM σ_λ=.00943° .286 KM	σ_u=.0268° .812 KM σ_λ=.0123° .373 KM	σ_u=.0559° 1.69 KM σ_λ=.0224° .679 KM	σ_u=.0551° 1.67 KM σ_λ=.0245° .742 KM	σ_u=.0544° 1.65 KM σ_λ=.0272° .824 KM	σ_u=.0285° .864 KM σ_λ=.0155° .470 KM	σ_u=.0177° .536 KM σ_λ=.0107° .324 KM	σ_u=.0179° .542 KM σ_λ=.0101° .306 KM
NAVIGATION	σ_u=.00492 σ_λ=.00457	σ_u=.00477 σ_λ=.00451	σ_u=.00491 σ_λ=.00455	σ_u=.00549 σ_λ=.00469	σ_u=.005461 σ_λ=.00472	σ_u=.00543 σ_λ=.00478	σ_u=.00493 σ_λ=.00460	σ_u=.00476 σ_λ=.00453	σ_u=.00477 σ_λ=.00452
ATTITUDE	σ_u=.0178 σ_λ=.0101	σ_u=.0106 σ_λ=.00676	σ_u=.0169 σ_λ=.00912	σ_u=.0423 σ_λ=.0181	σ_u=.0419 σ_λ=.0197	σ_u=.0416 σ_λ=.0217	σ_u=.0188 σ_λ=.0113	σ_u=.0105 σ_λ=.00737	σ_u=.0105 σ_λ=.00708
CAMERA ON-TIME	σ_u=.00073 σ_λ=.00172	σ_u=.00071 σ_λ=.00173	σ_u=.00074 σ_λ=.00172	σ_u=.00081 σ_λ=.00170	σ_u=.00079 σ_λ=.00170	σ_u=.00076 σ_λ=.00170	σ_u=.00073 σ_λ=.00172	σ_u=.00070 σ_λ=.00172	σ_u=.00071 σ_λ=.00172
MOON RADIUS	σ_u=.0205 σ_λ=.00802	σ_u=.0141 σ_λ=.00446	σ_u=.0202 σ_λ=.00663	σ_u=.0361 σ_λ=.0123	σ_u=.0354 σ_λ=.0138	σ_u=.0346 σ_λ=.0157	σ_u=.0209 σ_λ=.00958	σ_u=.0134 σ_λ=.00613	σ_u=.0137 σ_λ=.00537

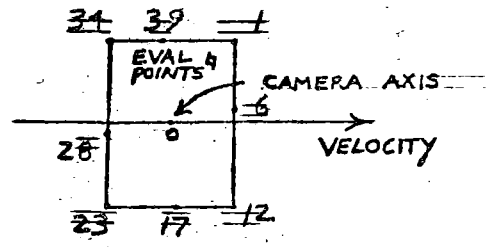
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.0294° .890 KM σ_λ=.0146° .443 KM	σ_u=.0144° .436 KM σ_λ=.00727° .220 KM	σ_u=.0297° .900 KM σ_λ=.00849° .257 KM	σ_u= ND° KM σ_λ= ND° KM	σ_u= ND° KM σ_λ= ND° KM	σ_u= ND° KM σ_λ= ND° KM	σ_u=.0300° .909 KM σ_λ=.0282° .855 KM	σ_u=.0115° .349 KM σ_λ=.0124° .376 KM	σ_u=.0127° .385 KM σ_λ=.00869° .263 KM
NAVIGATION	σ_u=.00492 σ_λ=.00457	σ_u=.00472 σ_λ=.00476	σ_u=.00496 σ_λ=.00447	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.00489 σ_λ=.00481	σ_u=.00468 σ_λ=.00456	σ_u=.00470 σ_λ=.00450
ATTITUDE	σ_u=.0204 σ_λ=.0112	σ_u=.00803 σ_λ=.00522	σ_u=.0188 σ_λ=.00697	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.0227 σ_λ=.0212	σ_u=.00797 σ_λ=.00792	σ_u=.00800 σ_λ=.00618
CAMERA ON-TIME	σ_u=.00073 σ_λ=.00172	σ_u=.00072 σ_λ=.00175	σ_u=.00080 σ_λ=.00175	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.000671 σ_λ=.00173	σ_u=.00068 σ_λ=.00173	σ_u=.00069 σ_λ=.00173
MOON RADIUS	σ_u=.0205 σ_λ=.00802	σ_u=.0109 σ_λ=.00161	σ_u=.0225 σ_λ=.00061	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.0189 σ_λ=.0179	σ_u=.00687 σ_λ=.00825	σ_u=.00866 σ_λ=.00377

* u = LATITUDE λ = LONGITUDE

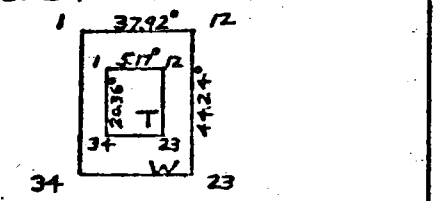
ERROR ANALYSIS RESULTS MISSION III FRAME 39





S/C ALTITUDE = 50.1 KM
TRUE ANOMALY = 356. °
INCLINATION ≈ 21. °
NOTE: R(-77°) P(-55°) Y(0°)

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

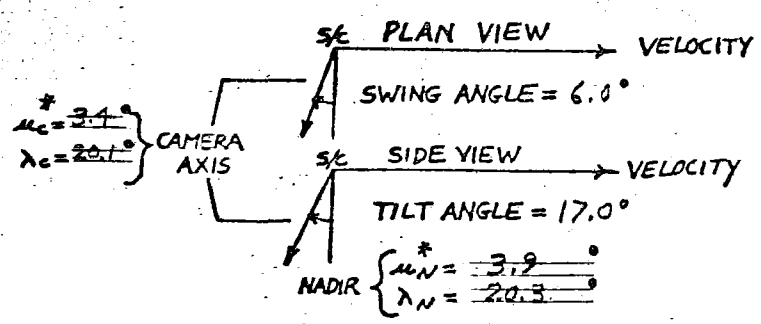
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.0148° .449 KM; σ_λ=.0493° 1.50 KM	σ_u=.00753° .228 KM; σ_λ=.0258° .781 KM	σ_u=.0140° .425 KM; σ_λ=.0418° 1.27 KM	σ_u=.1465° 4.44 KM; σ_λ=.4181° 12.7 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=.0160° .485 KM; σ_λ=.0606° 1.84 KM	σ_u=.00750° .212 KM; σ_λ=.0295° .896 KM	σ_u=.00719° .218 KM; σ_λ=.0278° .842 KM
NAVIGATION	σ_u= 0 σ_λ= 0	σ_u= 0 σ_λ= 0	σ_u= 0 σ_λ= 0	σ_u= 0 σ_λ= 0	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= 0 σ_λ= 0	σ_u= 0 σ_λ= 0	σ_u= 0 σ_λ= 0
ATTITUDE	σ_u=.0121 σ_λ=.0340	σ_u=.00687 σ_λ=.0139	σ_u=.0107 σ_λ=.0251	σ_u=.1366 σ_λ=.387	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.0138 σ_λ=.0421	σ_u=.00651 σ_λ=.0174	σ_u=.00631 σ_λ=.0157
CAMERA ON-TIME	σ_u=.00057 σ_λ=.00217	σ_u=.00063 σ_λ=.00191	σ_u=.00057 σ_λ=.00208	σ_u=.00134 σ_λ=.00771	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.00058 σ_λ=.00229	σ_u=.00054 σ_λ=.00134	σ_u=.00063 σ_λ=.00193
MOON RADIUS	σ_u=.00852 σ_λ=.0378	σ_u=.00441 σ_λ=.0217	σ_u=.00896 σ_λ=.0334	σ_u=.0531 σ_λ=.1579	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.00303 σ_λ=.0426	σ_u=.00243 σ_λ=.0239	σ_u=.00339 σ_λ=.0229

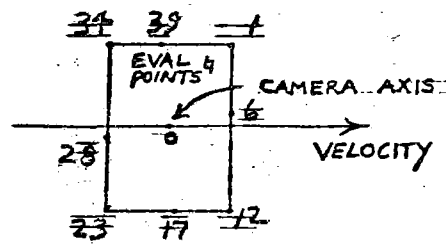
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.0141° .488 KM; σ_λ=.0526° 1.60 KM	σ_u=.00685° .208 KM; σ_λ=.0129° .391 KM	σ_u=.0160° .485 KM; σ_λ=.0247° .749 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=.00935° .298 KM; σ_λ=.0299° .905 KM	σ_u=.00472° .143 KM; σ_λ=.0194° .598 KM
NAVIGATION	σ_u= 0 σ_λ= 0	σ_u= 0 σ_λ= 0	σ_u= 0 σ_λ= 0	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= 0 σ_λ= 0	σ_u= 0 σ_λ= 0
ATTITUDE	σ_u=.0136 σ_λ=.0366	σ_u=.00391 σ_λ=.00651	σ_u=.00788 σ_λ=.0113	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.00771 σ_λ=.0217	σ_u=.00467 σ_λ=.0119
CAMERA ON-TIME	σ_u=.00057 σ_λ=.00217	σ_u=.00064 σ_λ=.00179	σ_u=.00057 σ_λ=.00189	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.00071 σ_λ=.00191	σ_u=.00066 σ_λ=.00184
MOON RADIUS	σ_u=.00852 σ_λ=.0378	σ_u=.00559 σ_λ=.0110	σ_u=.0140 σ_λ=.0219	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.00610 σ_λ=.0205	σ_u=.00319 σ_λ=.0152

* u = LATITUDE λ = LONGITUDE

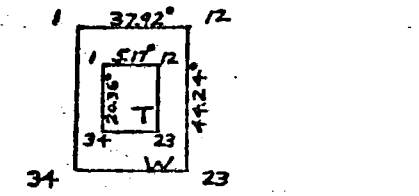
ERROR ANALYSIS RESULTS MISSION III FRAME 41





S/C ALTITUDE = 57.5 KM
TRUE ANOMALY = 348 °
INCLINATION ≈ 21 °
NOTE:

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

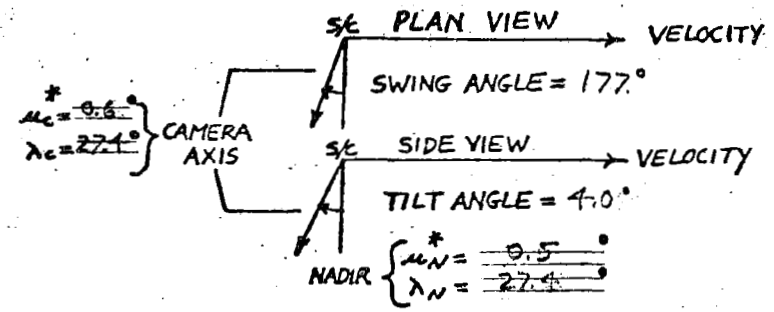
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00924° .249 KM; σ_λ = .00545° .165 KM	σ_u = .00606° .184 KM; σ_λ = .00550° .167 KM	σ_u = .00775° .235 KM; σ_λ = .00519° .157 KM	σ_u = .0189° .573 KM; σ_λ = .00556° .168 KM	σ_u = .0111° .336 KM; σ_λ = .00584° .177 KM	σ_u = .0113° .343 KM; σ_λ = .00628° .190 KM	σ_u = .00876° .263 KM; σ_λ = .00582° .176 KM	σ_u = .00672° .204 KM; σ_λ = .00592° .179 KM	σ_u = .00641° .194 KM; σ_λ = .00569° .172 KM
NAVIGATION	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0
ATTITUDE	σ_u = .00728 σ_λ = .00480	σ_u = .00582 σ_λ = .00519	σ_u = .00676 σ_λ = .00473	σ_u = .00859 σ_λ = .00477	σ_u = .00898 σ_λ = .00479	σ_u = .00945 σ_λ = .00487	σ_u = .00782 σ_λ = .00490	σ_u = .00659 σ_λ = .00543	σ_u = .00624 σ_λ = .00531
CAMERA ON-TIME	σ_u = .00063 σ_λ = .00175	σ_u = .00064 σ_λ = .00174	σ_u = .00063 σ_λ = .00175	σ_u = .00061 σ_λ = .00175	σ_u = .00061 σ_λ = .00176	σ_u = .00061 σ_λ = .00176	σ_u = .00063 σ_λ = .00176	σ_u = .00065 σ_λ = .00175	σ_u = .00064 σ_λ = .00175
MOON RADIUS	σ_u = .00375 σ_λ = .00190	σ_u = .00158 σ_λ = .00045	σ_u = .00374 σ_λ = .00122	σ_u = .00667 σ_λ = .00225	σ_u = .00646 σ_λ = .00284	σ_u = .00622 σ_λ = .00355	σ_u = .00376 σ_λ = .00260	σ_u = .00116 σ_λ = .00160	σ_u = .00135 σ_λ = .00108

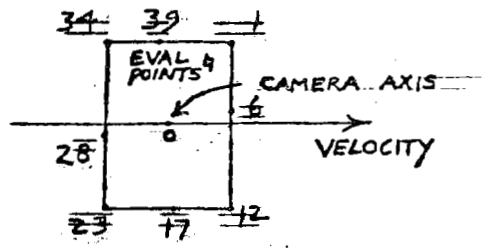
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00926° .281 KM; σ_λ = .00559° .169 KM	σ_u = .00327° .0990 KM; σ_λ = .00806° .244 KM	σ_u = .00681° .206 KM; σ_λ = .00594° .180 KM	σ_u = .0162° .491 KM; σ_λ = .00818° .248 KM	σ_u = .0178° .540 KM; σ_λ = .00714° .216 KM	σ_u = .0209° .633 KM; σ_λ = .0125° .379 KM	σ_u = .0128° .388 KM; σ_λ = .00994° .301 KM	σ_u = .0101° .306 KM; σ_λ = .00961° .291 KM	σ_u = .00680° .206 KM; σ_λ = .00742° .225 KM
NAVIGATION	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0
ATTITUDE	σ_u = .00844 σ_λ = .00495	σ_u = .00319 σ_λ = .00678	σ_u = .00470 σ_λ = .00496	σ_u = .0106 σ_λ = .00794	σ_u = .0143 σ_λ = .00572	σ_u = .0190 σ_λ = .00734	σ_u = .0125 σ_λ = .00697	σ_u = .00970 σ_λ = .00847	σ_u = .00662 σ_λ = .00720
CAMERA ON-TIME	σ_u = .00063 σ_λ = .00175	σ_u = .00065 σ_λ = .00172	σ_u = .00063 σ_λ = .00172	σ_u = .00059 σ_λ = .00173	σ_u = .00058 σ_λ = .00176	σ_u = .00057 σ_λ = .00183	σ_u = .00063 σ_λ = .00180	σ_u = .00068 σ_λ = .00179	σ_u = .00066 σ_λ = .00174
MOON RADIUS	σ_u = .00375 σ_λ = .00190	σ_u = .00021 σ_λ = .00400	σ_u = .00489 σ_λ = .00279	σ_u = .0123 σ_λ = .00095	σ_u = .0106 σ_λ = .00390	σ_u = .00866 σ_λ = .00993	σ_u = .00259 σ_λ = .00686	σ_u = .00283 σ_λ = .00418	σ_u = .00142 σ_λ = .00040

* μ = LATITUDE λ = LONGITUDE

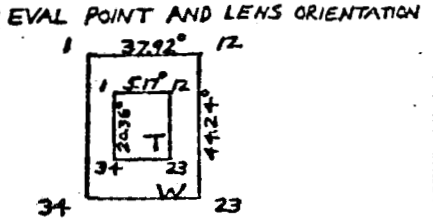
ERROR ANALYSIS RESULTS MISSION III FRAME 47





S/C ALTITUDE = 497 KM
TRUE ANOMALY = 358°
INCLINATION ≈ 21°
NOTE:

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

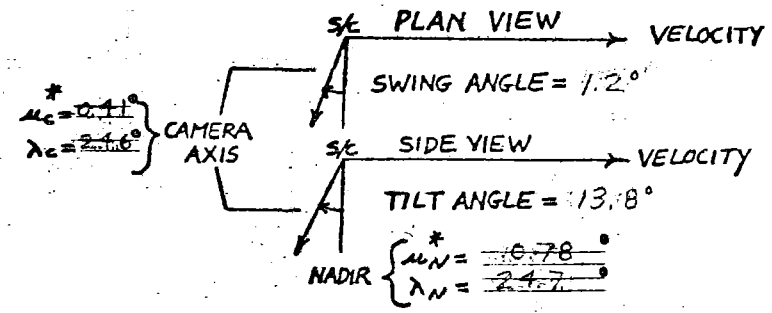
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00573° .174 KM; σ_λ = .00339° .103 KM	σ_u = .00597° .181 KM; σ_λ = .00433° .132 KM	σ_u = .00540° .164 KM; σ_λ = .00350° .106 KM	σ_u = .00609° .184 KM; σ_λ = .00320° .097 KM	σ_u = .00623° .190 KM; σ_λ = .00325° .099 KM	σ_u = .00652° .198 KM; σ_λ = .00343° .104 KM	σ_u = .00676° .184 KM; σ_λ = .00341° .119 KM	σ_u = .00677° .210 KM; σ_λ = .00410° .124 KM	σ_u = .00691° .195 KM; σ_λ = .00416° .126 KM
NAVIGATION	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0
ATTITUDE	σ_u = .00563; σ_λ = .00290	σ_u = .00515; σ_λ = .00360	σ_u = .00529; σ_λ = .00291	σ_u = .00584; σ_λ = .00269	σ_u = .00608; σ_λ = .00268	σ_u = .00638; σ_λ = .00269	σ_u = .00596; σ_λ = .00290	σ_u = .00582; σ_λ = .00367	σ_u = .00551; σ_λ = .00363
CAMERA ON-TIME	σ_u = .00067; σ_λ = .00174	σ_u = .00067; σ_λ = .00174	σ_u = .00067; σ_λ = .00174	σ_u = .00067; σ_λ = .00174	σ_u = .00067; σ_λ = .00174	σ_u = .00067; σ_λ = .00174	σ_u = .00068; σ_λ = .00174	σ_u = .00067; σ_λ = .00174	σ_u = .00067; σ_λ = .00174
MOON RADIUS	σ_u = .00027; σ_λ = .00021	σ_u = .00295; σ_λ = .00167	σ_u = .00035; σ_λ = .00086	σ_u = .00160; σ_λ = .00008	σ_u = .00140; σ_λ = .00059	σ_u = .00117; σ_λ = .00121	σ_u = .00099; σ_λ = .00093	σ_u = .00339; σ_λ = .00052	σ_u = .00319; σ_λ = .00104

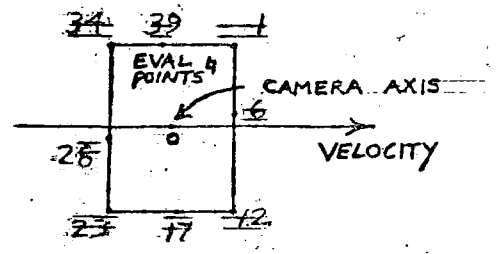
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00664° .201 KM; σ_λ = .00349° .106 KM	σ_u = .00573° .174 KM; σ_λ = .00906° .275 KM	σ_u = .00396° .120 KM; σ_λ = .00596° .181 KM	σ_u = .00865° .262 KM; σ_λ = .00544° .165 KM	σ_u = .00926° .281 KM; σ_λ = .00391° .118 KM	σ_u = .01093° .331 KM; σ_λ = .00679° .212 KM	σ_u = .00970° .295 KM; σ_λ = .00585° .178 KM	σ_u = .01311° .397 KM; σ_λ = .00652° .198 KM	σ_u = .00953° .289 KM; σ_λ = .00695° .192 KM
NAVIGATION	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0
ATTITUDE	σ_u = .00655; σ_λ = .00301	σ_u = .00351; σ_λ = .00580	σ_u = .00389; σ_λ = .00314	σ_u = .00641; σ_λ = .00449	σ_u = .00813; σ_λ = .00324	σ_u = .01061; σ_λ = .00318	σ_u = .00945; σ_λ = .00355	σ_u = .01041; σ_λ = .00587	σ_u = .00709; σ_λ = .00581
CAMERA ON-TIME	σ_u = .00067; σ_λ = .00174	σ_u = .00067; σ_λ = .00174	σ_u = .00067; σ_λ = .00174	σ_u = .00067; σ_λ = .00174	σ_u = .00066; σ_λ = .00174	σ_u = .00066; σ_λ = .00175	σ_u = .00067; σ_λ = .00175	σ_u = .00069; σ_λ = .00175	σ_u = .00062; σ_λ = .00174
MOON RADIUS	σ_u = .00087; σ_λ = .00028	σ_u = .00498; σ_λ = .00673	σ_u = .00035; σ_λ = .00474	σ_u = .00578; σ_λ = .00254	σ_u = .00430; σ_λ = .00133	σ_u = .00255; σ_λ = .00597	σ_u = .00209; σ_λ = .00430	σ_u = .00795; σ_λ = .00225	σ_u = .00634; σ_λ = .00185

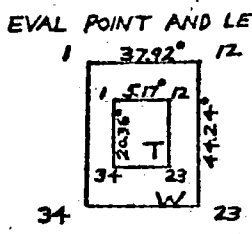
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION III FRAME 55





S/C ALTITUDE = 48.5 KM
TRUE ANOMALY = 356.
INCLINATION ≈ 21°
NOTE: APOLLO TGT. IIIP-5A



TELEPHOTO LENS, T

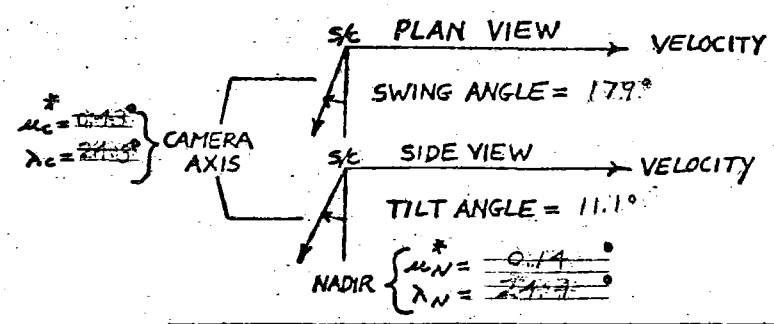
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u=.00666° .202KM ∇_λ=.00391° .118 KM	∇_u=.00516° .153 KM ∇_λ=.00391° .118 KM	∇_u=.00642° .194 KM ∇_λ=.00370° .112 KM	∇_u=.00899° .272 KM ∇_λ=.00394° .119 KM	∇_u=.00899° .272 KM ∇_λ=.00424° .128 KM	∇_u=.00901° .273 KM ∇_λ=.00469° .142 KM	∇_u=.00691° .210 KM ∇_λ=.00424° .128 KM	∇_u=.00550° .167 KM ∇_λ=.00414° .125 KM	∇_u=.00534° .162 KM ∇_λ=.00400° .121 KM
NAVIGATION	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0
ATTITUDE	∇_u=.00586 ∇_λ=.00324	∇_u=.00501 ∇_λ=.00351	∇_u=.00588 ∇_λ=.00320	∇_u=.00677 ∇_λ=.00310	∇_u=.00695 ∇_λ=.00314	∇_u=.00716 ∇_λ=.00322	∇_u=.00614 ∇_λ=.00330	∇_u=.00543 ∇_λ=.00362	∇_u=.00524 ∇_λ=.00356
CAMERA ON-TIME	∇_u=.00066 ∇_λ=.00174	∇_u=.00067 ∇_λ=.00174	∇_u=.00066 ∇_λ=.00174	∇_u=.00066 ∇_λ=.00174	∇_u=.00066 ∇_λ=.00174	∇_u=.00066 ∇_λ=.00175	∇_u=.00066 ∇_λ=.00174	∇_u=.00067 ∇_λ=.00174	∇_u=.00067 ∇_λ=.00174
MOON RADIUS	∇_u=.00311 ∇_λ=.00133	∇_u=.00102 ∇_λ=.00011	∇_u=.00312 ∇_λ=.00066	∇_u=.00588 ∇_λ=.00168	∇_u=.00567 ∇_λ=.00224	∇_u=.00542 ∇_λ=.00292	∇_u=.00310 ∇_λ=.00200	∇_u=.00059 ∇_λ=.01010	∇_u=.00078 ∇_λ=.00050

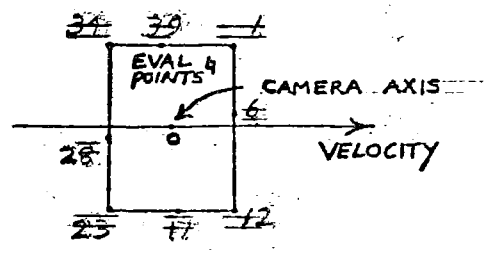
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u=.00781° .228 KM ∇_λ=.00404° .122KM	∇_u=.00390° .118 KM ∇_λ=.00679° .205 KM	∇_u=.00652° .198 KM ∇_λ=.00500° .151 KM	∇_u=.01452° .440KM ∇_λ=.00496° .150 KM	∇_u=.01428° .432KM ∇_λ=.00499° .151 KM	∇_u=.01465° .444 KM ∇_λ=.01027° .311 KM	∇_u=.00910° .276 KM ∇_λ=.00779° .236 KM	∇_u=.00841° .255 KM ∇_λ=.00653° .198 KM	∇_u=.00623° .189 KM ∇_λ=.00503° .152 KM
NAVIGATION	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0
ATTITUDE	∇_u=.00680 ∇_λ=.00340	∇_u=.00383 ∇_λ=.00467	∇_u=.00983 ∇_λ=.00336	∇_u=.00920 ∇_λ=.00495	∇_u=.01068 ∇_λ=.00336	∇_u=.01261 ∇_λ=.00500	∇_u=.00886 ∇_λ=.00457	∇_u=.00766 ∇_λ=.00522	∇_u=.00587 ∇_λ=.00472
CAMERA ON-TIME	∇_u=.00066 ∇_λ=.00174	∇_u=.00067 ∇_λ=.00174	∇_u=.00067 ∇_λ=.00174	∇_u=.00067 ∇_λ=.00174	∇_u=.00066 ∇_λ=.00174	∇_u=.00065 ∇_λ=.00177	∇_u=.00066 ∇_λ=.00176	∇_u=.00068 ∇_λ=.00175	∇_u=.00067 ∇_λ=.00174
MOON RADIUS	∇_u=.00311 ∇_λ=.00133	∇_u=.00029 ∇_λ=.00461	∇_u=.00433 ∇_λ=.00328	∇_u=.01121 ∇_λ=.00135	∇_u=.00946 ∇_λ=.00325	∇_u=.00743 ∇_λ=.00880	∇_u=.00188 ∇_λ=.00606	∇_u=.00340 ∇_λ=.00351	∇_u=.00197 ∇_λ=.00020

* u = LATITUDE λ = LONGITUDE

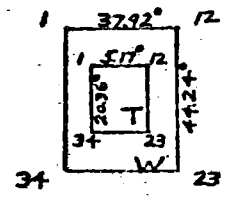
ERROR ANALYSIS RESULTS MISSION III FRAME 63





S/C ALTITUDE = 477 KM
TRUE ANOMALY = 359°
INCLINATION ≈ 21°
NOTE: APOLLO TGT, TEP-5B

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

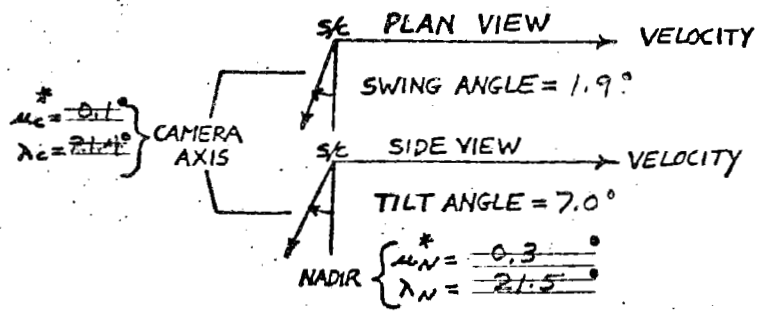
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00618° .187 KM; σ_λ=.00348° .105 KM	σ_u=.00708° .214 KM; σ_λ=.00481° .145 KM	σ_u=.00583° .177 KM; σ_λ=.00372° .115 KM	σ_u=.00565° .172 KM; σ_λ=.00326° .0989 KM	σ_u=.00593° .180 KM; σ_λ=.00319° .0965 KM	σ_u=.00628° .190 KM; σ_λ=.00324° .0982 KM	σ_u=.00653° .198 KM; σ_λ=.00336° .104 KM	σ_u=.00801° .243 KM; σ_λ=.00439° .136 KM	σ_u=.00758° .230 KM; σ_λ=.00455° .138 KM
NAVIGATION	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0
ATTITUDE	σ_u=.00563; σ_λ=.00289	σ_u=.00528; σ_λ=.00379	σ_u=.00526; σ_λ=.00292	σ_u=.00561; σ_λ=.00269	σ_u=.00589; σ_λ=.00268	σ_u=.00623; σ_λ=.00267	σ_u=.00600; σ_λ=.00287	σ_u=.00611; σ_λ=.00385	σ_u=.00593; σ_λ=.00382
CAMERA ON-TIME	σ_u=.000670; σ_λ=.00174	σ_u=.000671; σ_λ=.00174	σ_u=.000670; σ_λ=.00174	σ_u=.000670; σ_λ=.00174	σ_u=.000670; σ_λ=.00174	σ_u=.000670; σ_λ=.00174	σ_u=.000671; σ_λ=.00174	σ_u=.000673; σ_λ=.00174	σ_u=.000672; σ_λ=.00174
MOON RADIUS	σ_u=.00245; σ_λ=.000865	σ_u=.00467; σ_λ=.00240	σ_u=.00244; σ_λ=.00153	σ_u=.000029; σ_λ=.000559	σ_u=.000165; σ_λ=.000051	σ_u=.000398; σ_λ=.000560	σ_u=.00246; σ_λ=.000207	σ_u=.00513; σ_λ=.00120	σ_u=.00492; σ_λ=.00174

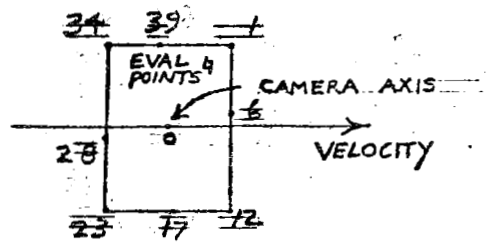
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00704° .213 KM; σ_λ=.00357° .108 KM	σ_u=.00728° .221 KM; σ_λ=.01043° .315 KM	σ_u=.00375° .113 KM; σ_λ=.00658° .199 KM	σ_u=.00679° .212 KM; σ_λ=.00572° .179 KM	σ_u=.00806° .244 KM; σ_λ=.00394° .119 KM	σ_u=.01037° .312 KM; σ_λ=.00631° .192 KM	σ_u=.01044° .322 KM; σ_λ=.00531° .162 KM	σ_u=.01596° .482 KM; σ_λ=.00688° .206 KM	σ_u=.01158° .348 KM; σ_λ=.00735° .223 KM
NAVIGATION	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0
ATTITUDE	σ_u=.00656; σ_λ=.00299	σ_u=.00328; σ_λ=.00653	σ_u=.00348; σ_λ=.00318	σ_u=.00566; σ_λ=.00475	σ_u=.00757; σ_λ=.00347	σ_u=.01031; σ_λ=.00323	σ_u=.00996; σ_λ=.00337	σ_u=.01225; σ_λ=.00612	σ_u=.00987; σ_λ=.00662
CAMERA ON-TIME	σ_u=.000671; σ_λ=.00174	σ_u=.000663; σ_λ=.00175	σ_u=.000669; σ_λ=.00174	σ_u=.000673; σ_λ=.00174	σ_u=.000669; σ_λ=.00174	σ_u=.000668; σ_λ=.00175	σ_u=.000676; σ_λ=.00175	σ_u=.000690; σ_λ=.00174	σ_u=.000675; σ_λ=.00174
MOON RADIUS	σ_u=.00245; σ_λ=.000865	σ_u=.00647; σ_λ=.00794	σ_u=.00123; σ_λ=.00549	σ_u=.00404; σ_λ=.00308	σ_u=.00261; σ_λ=.000656	σ_u=.000919; σ_λ=.00573	σ_u=.00369; σ_λ=.00371	σ_u=.01020; σ_λ=.00175	σ_u=.00847; σ_λ=.00267

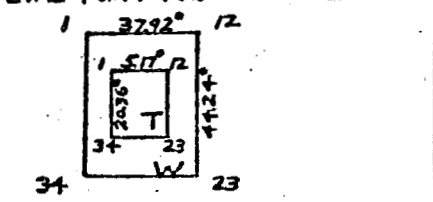
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION III FRAME 69





S/C ALTITUDE = 17.6 KM
TRUE ANOMALY = 358. °
INCLINATION ≈ 21. °
NOTE:



TELEPHOTO LENS, T

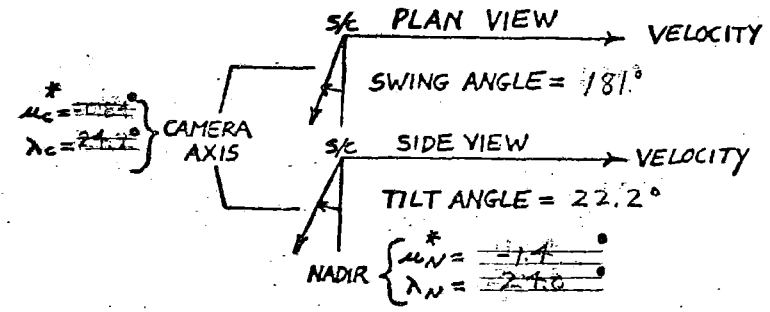
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00609° .184 KM; σ_λ=.00352° .107KM	σ_u=.00529° .160KM; σ_λ=.00387° .118 KM	σ_u=.00584° .177KM; σ_λ=.00344° .102KM	σ_u=.00767° .232KM; σ_λ=.00345° .103KM	σ_u=.00772° .235KM; σ_λ=.00366° .111 KM	σ_u=.00780° .237 KM; σ_λ=.00401° .122KM	σ_u=.00635° .193 KM; σ_λ=.00374° .113 KM	σ_u=.00578° .175KM; σ_λ=.00392° .119 KM	σ_u=.00555° .168 KM; σ_λ=.00346° .117 KM
NAVIGATION	σ_u=.00180; σ_λ=.00048	σ_u=.00180; σ_λ=.00047	σ_u=.00130; σ_λ=.00048	σ_u=.00182; σ_λ=.00049	σ_u=.00184; σ_λ=.00049	σ_u=.00182; σ_λ=.00050	σ_u=.00180; σ_λ=.00049	σ_u=.00179; σ_λ=.00048	σ_u=.00180; σ_λ=.00048
ATTITUDE	σ_u=.00556; σ_λ=.00274	σ_u=.00489; σ_λ=.00336	σ_u=.00528; σ_λ=.00297	σ_u=.00616; σ_λ=.00275	σ_u=.00635; σ_λ=.00277	σ_u=.00659; σ_λ=.00282	σ_u=.00585; σ_λ=.00297	σ_u=.00538; σ_λ=.00346	σ_u=.00516; σ_λ=.00341
CAMERA ON-TIME	σ_u=.00068; σ_λ=.00174	σ_u=.00068; σ_λ=.00174	σ_u=.00068; σ_λ=.00174	σ_u=.00068; σ_λ=.00174	σ_u=.00067; σ_λ=.00174	σ_u=.00067; σ_λ=.00174	σ_u=.00069; σ_λ=.00174	σ_u=.00068; σ_λ=.00174	σ_u=.00068; σ_λ=.00174
MOON RADIUS	σ_u=.00155; σ_λ=.00072	σ_u=.00142; σ_λ=.00070	σ_u=.00157; σ_λ=.00067	σ_u=.00414; σ_λ=.00103	σ_u=.00393; σ_λ=.00157	σ_u=.00369; σ_λ=.00221	σ_u=.00154; σ_λ=.00137	σ_u=.00091; σ_λ=.00092	σ_u=.00071; σ_λ=.00069

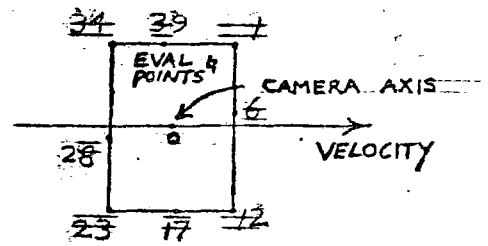
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00693° .211 KM; σ_λ=.00364° .110 KM	σ_u=.00449° .136KM; σ_λ=.00742° .216KM	σ_u=.00550° .167 KM; σ_λ=.00522° .152KM	σ_u=.01190° .362 KM; σ_λ=.00492° .149 KM	σ_u=.01129° .361 KM; σ_λ=.00429° .130KM	σ_u=.01261° .382KM; σ_λ=.00861° .260KM	σ_u=.00895° .272KM; σ_λ=.00686° .210KM	σ_u=.00985° .298KM; σ_λ=.00627° .190KM	σ_u=.00729° .221KM; σ_λ=.00525° .159 KM
NAVIGATION	σ_u=.00180; σ_λ=.00042	σ_u=.00179; σ_λ=.00044	σ_u=.00181; σ_λ=.00045	σ_u=.00185; σ_λ=.00046	σ_u=.00184; σ_λ=.00050	σ_u=.00183; σ_λ=.00054	σ_u=.00180; σ_λ=.00052	σ_u=.00178; σ_λ=.00050	σ_u=.00179; σ_λ=.00047
ATTITUDE	σ_u=.00648; σ_λ=.00308	σ_u=.00263; σ_λ=.00484	σ_u=.00434; σ_λ=.00311	σ_u=.00769; σ_λ=.00422	σ_u=.00922; σ_λ=.00304	σ_u=.01124; σ_λ=.00378	σ_u=.00874; σ_λ=.00394	σ_u=.00926; σ_λ=.00520	σ_u=.00608; σ_λ=.00466
CAMERA ON-TIME	σ_u=.00068; σ_λ=.00174	σ_u=.00068; σ_λ=.00174	σ_u=.00068; σ_λ=.00174	σ_u=.00068; σ_λ=.00174	σ_u=.00067; σ_λ=.00174	σ_u=.00067; σ_λ=.00176	σ_u=.00068; σ_λ=.00175	σ_u=.00069; σ_λ=.00174	σ_u=.00068; σ_λ=.00174
MOON RADIUS	σ_u=.00155; σ_λ=.00072	σ_u=.00181; σ_λ=.00533	σ_u=.00277; σ_λ=.00379	σ_u=.00886; σ_λ=.00180	σ_u=.00725; σ_λ=.00243	σ_u=.00536; σ_λ=.00752	σ_u=.00333; σ_λ=.00531	σ_u=.00501; σ_λ=.00300	σ_u=.00354; σ_λ=.00221

* σ_u = LATITUDE σ_λ = LONGITUDE

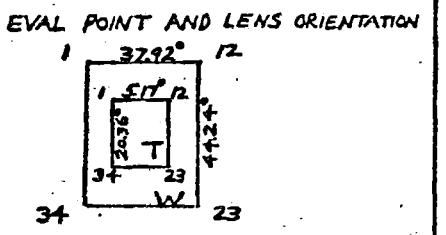
ERROR ANALYSIS RESULTS MISSION III FRAME 72





S/C ALTITUDE = 474 KM
TRUE ANOMALY = 2.8°
INCLINATION = 21°
NOTE: APOLLO TGT. III S-5

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

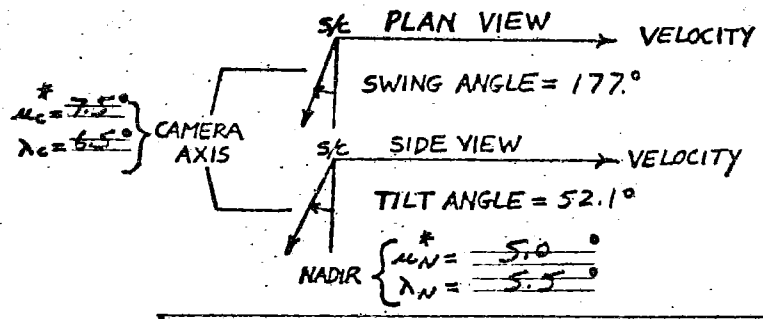
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00832° .252 KM; σ_λ=.00445° .135 KM	σ_u=.01037° .312 KM; σ_λ=.00614° .186 KM	σ_u=.00807° .242 KM; σ_λ=.00486° .147 KM	σ_u=.00652° .197 KM; σ_λ=.00414° .125 KM	σ_u=.00684° .207 KM; σ_λ=.00395° .119 KM	σ_u=.00722° .218 KM; σ_λ=.00382° .116 KM	σ_u=.00856° .259 KM; σ_λ=.00415° .125 KM	σ_u=.01134° .142 KM; σ_λ=.00536° .163 KM	σ_u=.01089° .327 KM; σ_λ=.00569° .172 KM
NAVIGATION	σ_u=.00176; σ_λ=.00178	σ_u=.00176; σ_λ=.00177	σ_u=.00176; σ_λ=.00177	σ_u=.00176; σ_λ=.00178	σ_u=.00176; σ_λ=.00178	σ_u=.00176; σ_λ=.00179	σ_u=.00176; σ_λ=.00178	σ_u=.00176; σ_λ=.00178	σ_u=.00176; σ_λ=.00177
ATTITUDE	σ_u=.00629; σ_λ=.00315	σ_u=.00661; σ_λ=.00422	σ_u=.00596; σ_λ=.00323	σ_u=.00576; σ_λ=.00290	σ_u=.00603; σ_λ=.00298	σ_u=.00636; σ_λ=.00286	σ_u=.00662; σ_λ=.00308	σ_u=.00754; σ_λ=.00412	σ_u=.00711; σ_λ=.00417
CAMERA ON-TIME	σ_u=.000671; σ_λ=.00174	σ_u=.000665; σ_λ=.00174	σ_u=.000670; σ_λ=.00174	σ_u=.000675; σ_λ=.00174	σ_u=.000625; σ_λ=.00174	σ_u=.000676; σ_λ=.00174	σ_u=.000672; σ_λ=.00174	σ_u=.000668; σ_λ=.00174	σ_u=.000666; σ_λ=.00174
MOON RADIUS	σ_u=.00511; σ_λ=.00194	σ_u=.00776; σ_λ=.00369	σ_u=.00512; σ_λ=.00265	σ_u=.00242; σ_λ=.00158	σ_u=.00261; σ_λ=.00106	σ_u=.00285; σ_λ=.00432	σ_u=.00510; σ_λ=.00123	σ_u=.00826; σ_λ=.00236	σ_u=.00803; σ_λ=.00296

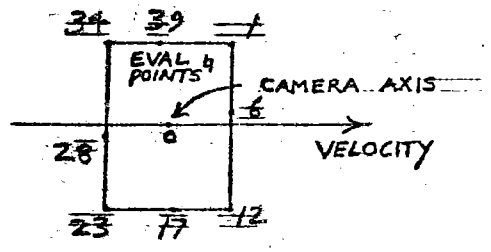
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00915° .277 KM; σ_λ=.00453° .137 KM	σ_u=.01211° .366 KM; σ_λ=.01367° .414 KM	σ_u=.00606° .184 KM; σ_λ=.00828° .252 KM	σ_u=.00601° .182 KM; σ_λ=.00640° .194 KM	σ_u=.00940° .224 KM; σ_λ=.00424° .128 KM	σ_u=.00984° .285 KM; σ_λ=.00587° .178 KM	σ_u=.01258° .379 KM; σ_λ=.00499° .150 KM	σ_u=.02265° .685 KM; σ_λ=.00659° .199 KM	σ_u=.01721° .517 KM; σ_λ=.00895° .271 KM
NAVIGATION	σ_u=.00176; σ_λ=.00178	σ_u=.00178; σ_λ=.00175	σ_u=.00176; σ_λ=.00176	σ_u=.00177; σ_λ=.00176	σ_u=.00176; σ_λ=.00179	σ_u=.00176; σ_λ=.00182	σ_u=.00175; σ_λ=.00181	σ_u=.00178; σ_λ=.00180	σ_u=.00178; σ_λ=.00177
ATTITUDE	σ_u=.00736; σ_λ=.00325	σ_u=.00585; σ_λ=.00837	σ_u=.00428; σ_λ=.00380	σ_u=.00548; σ_λ=.00431	σ_u=.00716; σ_λ=.00341	σ_u=.00954; σ_λ=.00345	σ_u=.01069; σ_λ=.00320	σ_u=.01709; σ_λ=.00602	σ_u=.01147; σ_λ=.00750
CAMERA ON-TIME	σ_u=.000671; σ_λ=.00174	σ_u=.000644; σ_λ=.00177	σ_u=.000667; σ_λ=.00176	σ_u=.000684; σ_λ=.00175	σ_u=.000680; σ_λ=.00173	σ_u=.000680; σ_λ=.00173	σ_u=.000678; σ_λ=.00174	σ_u=.000681; σ_λ=.00174	σ_u=.000661; σ_λ=.00174
MOON RADIUS	σ_u=.00511; σ_λ=.00194	σ_u=.01043; σ_λ=.01051	σ_u=.00386; σ_λ=.00693	σ_u=.00155; σ_λ=.00403	σ_u=.00168; σ_λ=.00353	σ_u=.00148; σ_λ=.00402	σ_u=.00635; σ_λ=.00289	σ_u=.01474; σ_λ=.00101	σ_u=.01271; σ_λ=.00422

* u = LATITUDE λ = LONGITUDE

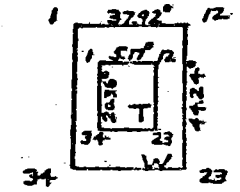
ERROR ANALYSIS RESULTS MISSION III FRAME 73





S/C ALTITUDE = 62.0 KM
TRUE ANOMALY = 345. °
INCLINATION = 21. °
NOTE:

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

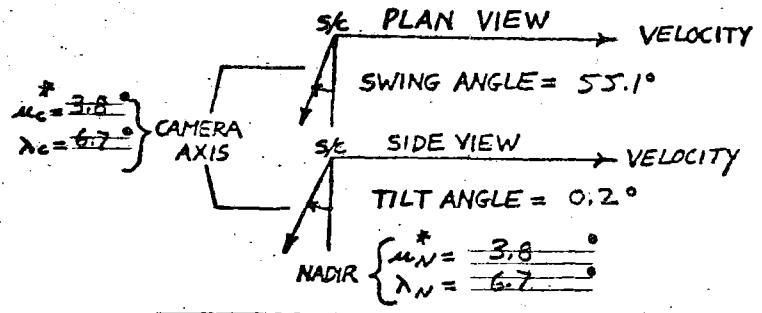
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.0247° .748KM; σ_λ=.0114° .376 KM	σ_u=.0400° 1.212 KM; σ_λ=.0227° .6878 KM	σ_u=.0242° .7332 KM; σ_λ=.0127° .3848 KM	σ_u=.0163° .4938 KM; σ_λ=.0081° .2454 KM	σ_u=.0171° .4171 KM; σ_λ=.0077° .2333 KM	σ_u=.0181° .5484 KM; σ_λ=.0072° .2181 KM	σ_u=.0251° .7605 KM; σ_λ=.0103° .312 KM	σ_u=.0459° 1.39 KM; σ_λ=.0207° .6272 KM	σ_u=.0431° 1.305 KM; σ_λ=.0217° .6575 KM
NAVIGATION	σ_u=.0010 σ_λ=.0026	σ_u=.0011 σ_λ=.0025	σ_u=.0010 σ_λ=.0025	σ_u=.0010 σ_λ=.0026	σ_u=.0010 σ_λ=.0026	σ_u=.0010 σ_λ=.0026	σ_u=.0010 σ_λ=.0026	σ_u=.0012 σ_λ=.0025	σ_u=.0011 σ_λ=.0025
ATTITUDE	σ_u=.0175 σ_λ=.0089	σ_u=.0296 σ_λ=.0190	σ_u=.0166 σ_λ=.0095	σ_u=.0115 σ_λ=.0057	σ_u=.0124 σ_λ=.0057	σ_u=.0134 σ_λ=.0055	σ_u=.0184 σ_λ=.0083	σ_u=.0361 σ_λ=.0183	σ_u=.0330 σ_λ=.0187
CAMERA ON-TIME	σ_u=.0008 σ_λ=.0017	σ_u=.0009 σ_λ=.0016	σ_u=.0008 σ_λ=.0017	σ_u=.0008 σ_λ=.0017	σ_u=.0008 σ_λ=.0017	σ_u=.0008 σ_λ=.0017	σ_u=.0008 σ_λ=.0017	σ_u=.0009 σ_λ=.0017	σ_u=.0009 σ_λ=.0016
MOON RADIUS	σ_u=.0173 σ_λ=.0065	σ_u=.0269 σ_λ=.0121	σ_u=.0175 σ_λ=.0077	σ_u=.0114 σ_λ=.0050	σ_u=.0118 σ_λ=.0043	σ_u=.0121 σ_λ=.0035	σ_u=.0171 σ_λ=.0053	σ_u=.0283 σ_λ=.0094	σ_u=.0277 σ_λ=.0106

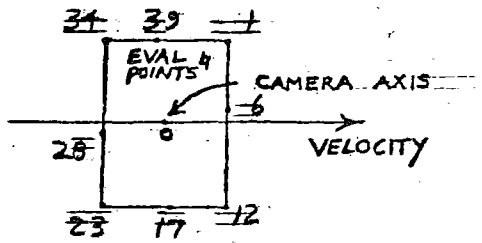
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.0268° .812KM; σ_λ=.0120° .3637 KM	σ_u=.2441° 7.39 KM; σ_λ=.2484° 7.55 KM	σ_u=.0178° .535 KM; σ_λ=.0187° .566 KM	σ_u=.0092° .278 KM; σ_λ=.0099° .299 KM	σ_u=.0135° .409 KM; σ_λ=.0066° .199 KM	σ_u=.0202° .612 KM; σ_λ=.0072° .238 KM	σ_u=.0393° 1.191 KM; σ_λ=.0077° .233 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=.5569° 1.788 KM; σ_λ=.2430° 7.36 KM
NAVIGATION	σ_u=.0010 σ_λ=.0026	σ_u=.0018 σ_λ=.0018	σ_u=.0009 σ_λ=.0025	σ_u=.0008 σ_λ=.0025	σ_u=.0008 σ_λ=.0026	σ_u=.0009 σ_λ=.0027	σ_u=.0011 σ_λ=.0027	σ_u= σ_λ=	σ_u=.0034 σ_λ=.0017
ATTITUDE	σ_u=.0204 σ_λ=.0096	σ_u=.2260 σ_λ=.2347	σ_u=.0089 σ_λ=.0111	σ_u=.0080 σ_λ=.0062	σ_u=.0112 σ_λ=.0051	σ_u=.0176 σ_λ=.0060	σ_u=.0340 σ_λ=.0069	σ_u= σ_λ=	σ_u=.5449 σ_λ=.2390
CAMERA ON-TIME	σ_u=.0008 σ_λ=.0017	σ_u=.0007 σ_λ=.0017	σ_u=.0008 σ_λ=.0016	σ_u=.0007 σ_λ=.0017	σ_u=.0007 σ_λ=.0017	σ_u=.0008 σ_λ=.0018	σ_u=.0009 σ_λ=.0018	σ_u= σ_λ=	σ_u=.0020 σ_λ=.0012
MOON RADIUS	σ_u=.0173 σ_λ=.0065	σ_u=.0923 σ_λ=.0813	σ_u=.0153 σ_λ=.0148	σ_u=.0056 σ_λ=.0071	σ_u=.0073 σ_λ=.0029	σ_u=.0096 σ_λ=.0023	σ_u=.0195 σ_λ=.0013	σ_u= ↓ σ_λ= ↓	σ_u=.1146 σ_λ=.0437

* μ = LATITUDE λ = LONGITUDE

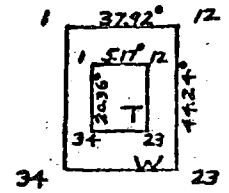
ERROR ANALYSIS RESULTS MISSION III FRAME 75





S/C ALTITUDE = 557 KM
TRUE ANOMALY = 348 °
INCLINATION = 21 °
NOTE:

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .00567° .172 KM; σ_λ = .00582° .152 KM	σ_μ = .00498° .151 KM; σ_λ = .00661° .200 KM	σ_μ = .00509° .154 KM; σ_λ = .00583° .177 KM	σ_μ = .00662° .201 KM; σ_λ = .00595° .180 KM	σ_μ = .00697° .211 KM; σ_λ = .00597° .181 KM	σ_μ = .00742° .225 KM; σ_λ = .00608° .184 KM	σ_μ = .00626° .190 KM; σ_λ = .00589° .178 KM	σ_μ = .00613° .186 KM; σ_λ = .00666° .202 KM	σ_μ = .00580° .170 KM; σ_λ = .00661° .200 KM
NAVIGATION	σ_μ = .00109; σ_λ = .00396	σ_μ = .00112; σ_λ = .00392	σ_μ = .00108; σ_λ = .00395	σ_μ = .00104; σ_λ = .00397	σ_μ = .00104; σ_λ = .00399	σ_μ = .00105; σ_λ = .00401	σ_μ = .00108; σ_λ = .00398	σ_μ = .00113; σ_λ = .00396	σ_μ = .00112; σ_λ = .00391
ATTITUDE	σ_μ = .00553; σ_λ = .00389	σ_μ = .00425; σ_λ = .00466	σ_μ = .00493; σ_λ = .00389	σ_μ = .00539; σ_λ = .00406	σ_μ = .00615; σ_λ = .00390	σ_μ = .00701; σ_λ = .00393	σ_μ = .00613; σ_λ = .00390	σ_μ = .00545; σ_λ = .00507	σ_μ = .00494; σ_λ = .00497
CAMERA ON-TIME	σ_μ = .00067; σ_λ = .00173	σ_μ = .00069; σ_λ = .00172	σ_μ = .00067; σ_λ = .00173	σ_μ = .00066; σ_λ = .00174	σ_μ = .00066; σ_λ = .00174	σ_μ = .00066; σ_λ = .00174	σ_μ = .00067; σ_λ = .00174	σ_μ = .00069; σ_λ = .00173	σ_μ = .00069; σ_λ = .00173
MOON RADIUS	σ_μ = .00003; σ_λ = .00012	σ_μ = .00203; σ_λ = .00121	σ_μ = .00004; σ_λ = .00053	σ_μ = .00225; σ_λ = .00041	σ_μ = .00233; σ_λ = .00095	σ_μ = .00209; σ_λ = .00156	σ_μ = .00002; σ_λ = .00077	σ_μ = .00247; σ_λ = .00116	σ_μ = .00227; σ_λ = .00065

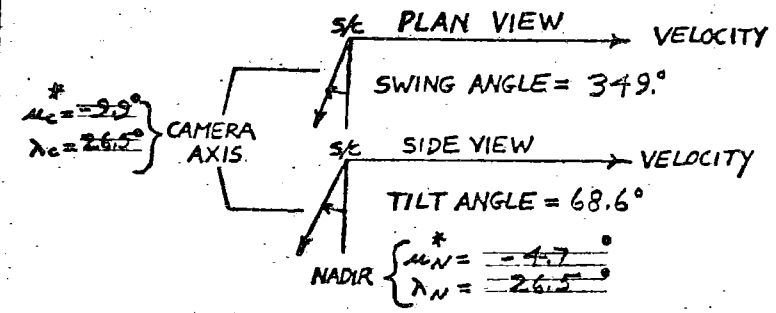
WIDE-ANGLE LENS, W

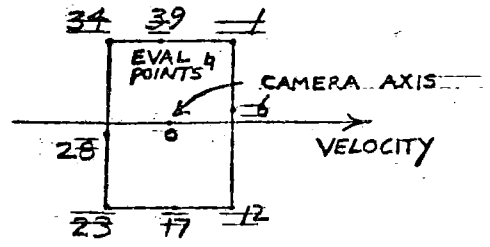
ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .00655° .198 KM; σ_λ = .00586° .178 KM	σ_μ = .00414° .125 KM; σ_λ = .0106° .321 KM	σ_μ = .00282° .0854 KM; σ_λ = .00747° .226 KM	σ_μ = .00891° .270 KM; σ_λ = .00963° .292 KM	σ_μ = .0107° .324 KM; σ_λ = .00766° .232 KM	σ_μ = .0146° .442 KM; σ_λ = .00935° .283 KM	σ_μ = .0117° .354 KM; σ_λ = .00817° .248 KM	σ_μ = .0128° .388 KM; σ_λ = .0107° .324 KM	σ_μ = .00790° .239 KM; σ_λ = .00952° .288 KM
NAVIGATION	σ_μ = .00108; σ_λ = .00396	σ_μ = .00114; σ_λ = .00380	σ_μ = .00106; σ_λ = .00384	σ_μ = .00099; σ_λ = .00389	σ_μ = .00100; σ_λ = .00401	σ_μ = .00101; σ_λ = .00418	σ_μ = .00110; σ_λ = .00412	σ_μ = .00123; σ_λ = .00405	σ_μ = .00118; σ_λ = .00392
ATTITUDE	σ_μ = .00641; σ_λ = .00397	σ_μ = .00176; σ_λ = .00757	σ_μ = .00220; σ_λ = .00432	σ_μ = .00555; σ_λ = .00832	σ_μ = .00920; σ_λ = .00605	σ_μ = .0141; σ_λ = .00454	σ_μ = .0115; σ_λ = .00496	σ_μ = .0107; σ_λ = .00936	σ_μ = .00571; σ_λ = .00838
CAMERA ON-TIME	σ_μ = .00067; σ_λ = .00173	σ_μ = .00069; σ_λ = .00170	σ_μ = .00067; σ_λ = .00171	σ_μ = .00064; σ_λ = .00172	σ_μ = .00064; σ_λ = .00174	σ_μ = .00064; σ_λ = .00179	σ_μ = .00068; σ_λ = .00178	σ_μ = .00073; σ_λ = .00176	σ_μ = .00071; σ_λ = .00172
MOON RADIUS	σ_μ = .00003; σ_λ = .00012	σ_μ = .00349; σ_λ = .00621	σ_μ = .00122; σ_λ = .00441	σ_μ = .00687; σ_λ = .00232	σ_μ = .00536; σ_λ = .00169	σ_μ = .00360; σ_λ = .00651	σ_μ = .00117; σ_λ = .00469	σ_μ = .00682; σ_λ = .00257	σ_μ = .00528; σ_λ = .00144

* μ = LATITUDE λ = LONGITUDE

UB 4802 1435 ORIG. 4-65

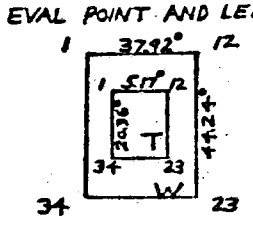
ERROR ANALYSIS RESULTS MISSION III FRAME 78





S/C ALTITUDE = 54.8 KM
TRUE ANOMALY = 11.4 °
INCLINATION ≈ 21. °
NOTE:

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

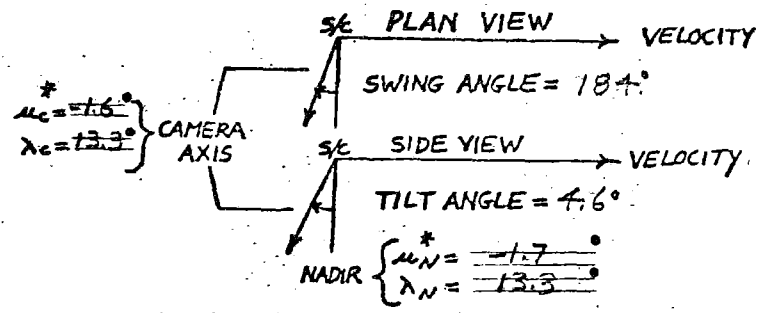
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.0829° 2.51 KM; σ_λ=.0134° .406 KM	σ_u=.0358° 1.08 KM; σ_λ=.0107° .324 KM	σ_u=.0758° 2.29 KM; σ_λ=.0126° .347 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=.0911° 2.76 KM; σ_λ=.0157° .475 KM	σ_u=.0355° 1.075 KM; σ_λ=.0112° .340 KM	σ_u=.0356° 1.078 KM; σ_λ=.0108° .328 KM
NAVIGATION	σ_u=.0025 σ_λ=.0055	σ_u=.0020 σ_λ=.0056	σ_u=.0025 σ_λ=.0056	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.0025 σ_λ=.0055	σ_u=.0020 σ_λ=.0055	σ_u=.0020 σ_λ=.0055
ATTITUDE	σ_u=.0702 σ_λ=.0121	σ_u=.0256 σ_λ=.0088	σ_u=.0627 σ_λ=.0110	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.0788 σ_λ=.0143	σ_u=.0264 σ_λ=.0096	σ_u=.0261 σ_λ=.0092
CAMERA ON-TIME	σ_u=.0012 σ_λ=.0018	σ_u=.0009 σ_λ=.0018	σ_u=.0012 σ_λ=.0018	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.0012 σ_λ=.0017	σ_u=.0009 σ_λ=.0017	σ_u=.0009 σ_λ=.0018
MOON RADIUS	σ_u=.0439 σ_λ=.0002	σ_u=.0247 σ_λ=.0021	σ_u=.0424 σ_λ=.0020	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.0456 σ_λ=.0026	σ_u=.0236 σ_λ=.0004	σ_u=.0241 σ_λ=.0007

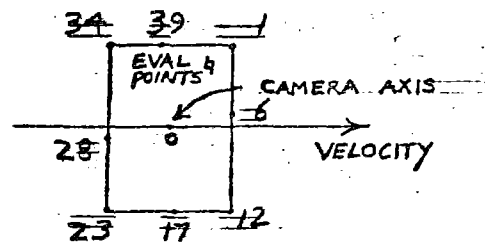
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.0917° 2.78 KM; σ_λ=.0141° .427 KM	σ_u=.0209° .636 KM; σ_λ=.0143° .438 KM	σ_u=.0885° 2.721 KM; σ_λ=.0332° 1.00 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=.105° 3.181 KM; σ_λ=.0458° 1.38 KM	σ_u=.0226° .685 KM; σ_λ=.0150° .455 KM	σ_u=.0216° .655 KM; σ_λ=.0111° .336 KM
NAVIGATION	σ_u=.0025 σ_λ=.0055	σ_u=.0019 σ_λ=.0057	σ_u=.0032 σ_λ=.0063	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.0022 σ_λ=.0054	σ_u=.0018 σ_λ=.0054	σ_u=.0018 σ_λ=.0055
ATTITUDE	σ_u=.0805 σ_λ=.0128	σ_u=.0120 σ_λ=.0097	σ_u=.0700 σ_λ=.0256	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.0971 σ_λ=.0427	σ_u=.0182 σ_λ=.0130	σ_u=.0157 σ_λ=.0095
CAMERA ON-TIME	σ_u=.0012 σ_λ=.0018	σ_u=.0009 σ_λ=.0018	σ_u=.0016 σ_λ=.0021	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.0010 σ_λ=.0016	σ_u=.0008 σ_λ=.0017	σ_u=.0008 σ_λ=.0018
MOON RADIUS	σ_u=.0439 σ_λ=.0002	σ_u=.0170 σ_λ=.0087	σ_u=.0540 σ_λ=.0200	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.0400 σ_λ=.0155	σ_u=.0134 σ_λ=.0047	σ_u=.0148 σ_λ=.0008

* u = LATITUDE λ = LONGITUDE

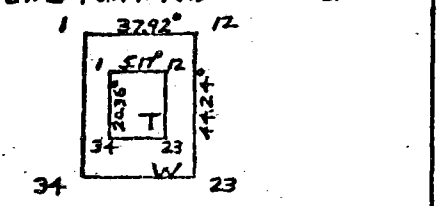
ERROR ANALYSIS RESULTS MISSION III FRAME 81





S/C ALTITUDE = 155 KM
TRUE ANOMALY = 3.3°
INCLINATION ≈ 21°
NOTE:

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

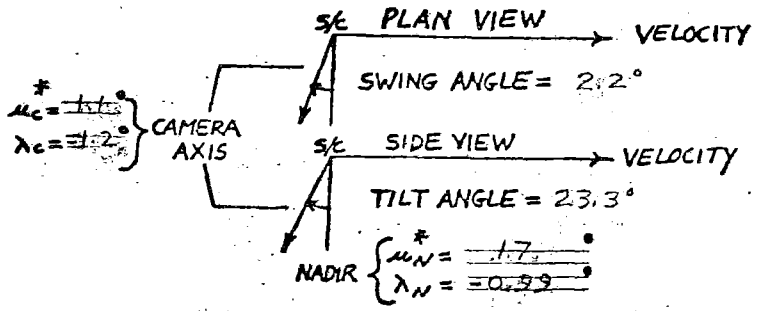
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.0055° .166 KM σ_λ=.0037° .112 KM	σ_μ=.0059° .178 KM σ_λ=.0045° .136 KM	σ_μ=.0052° .154 KM σ_λ=.0036° .108 KM	σ_μ=.0057° .173 KM σ_λ=.0035° .106 KM	σ_μ=.0058° .176 KM σ_λ=.0035° .106 KM	σ_μ=.0060° .182 KM σ_λ=.0037° .112 KM	σ_μ=.0057° .173 KM σ_λ=.0037° .112 KM	σ_μ=.0066° .200 KM σ_λ=.0041° .124 KM	σ_μ=.0063° .191 KM σ_λ=.0042° .127 KM
NAVIGATION	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0014
ATTITUDE	σ_μ=.0053 σ_λ=.0029	σ_μ=.0050 σ_λ=.0034	σ_μ=.0050 σ_λ=.0029	σ_μ=.0054 σ_λ=.0027	σ_μ=.0056 σ_λ=.0027	σ_μ=.0058 σ_λ=.0027	σ_μ=.0055 σ_λ=.0029	σ_μ=.0055 σ_λ=.0034	σ_μ=.0052 σ_λ=.0034
CAMERA ON-TIME	σ_μ=.0007 σ_λ=.0017	σ_μ=.0007 σ_λ=.0017	σ_μ=.0007 σ_λ=.0017	σ_μ=.0007 σ_λ=.0017	σ_μ=.0007 σ_λ=.0017	σ_μ=.0007 σ_λ=.0017	σ_μ=.0007 σ_λ=.0017	σ_μ=.0007 σ_λ=.0017	σ_μ=.0007 σ_λ=.0017
MOON RADIUS	σ_μ=.0010 σ_λ=.0004	σ_μ=.0030 σ_λ=.0018	σ_μ=.0009 σ_λ=.0010	σ_μ=.0015 σ_λ=.0001	σ_μ=.0013 σ_λ=.0004	σ_μ=.0011 σ_λ=.0010	σ_μ=.0010 σ_λ=.0003	σ_μ=.0035 σ_λ=.0007	σ_μ=.0033 σ_λ=.0012

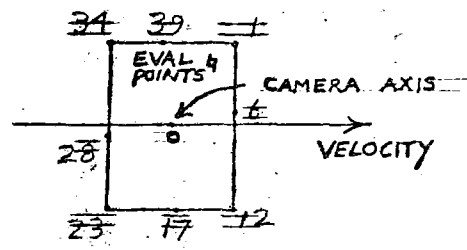
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.0043° .192 KM σ_λ=.0037° .112 KM	σ_μ=.0062° .188 KM σ_λ=.0090° .273 KM	σ_μ=.0043° .130 KM σ_λ=.0063° .192 KM	σ_μ=.0085° .258 KM σ_λ=.0052° .157 KM	σ_μ=.0086° .262 KM σ_λ=.0039° .118 KM	σ_μ=.0095° .288 KM σ_λ=.0070° .212 KM	σ_μ=.0086° .262 KM σ_λ=.0058° .176 KM	σ_μ=.0125° .3750 KM σ_λ=.0058° .176 KM	σ_μ=.0095° .288 KM σ_λ=.0058° .176 KM
NAVIGATION	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0013	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0014	σ_μ=.0009 σ_λ=.0014
ATTITUDE	σ_μ=.0061 σ_λ=.0030	σ_μ=.0040 σ_λ=.0053	σ_μ=.0041 σ_λ=.0032	σ_μ=.0062 σ_λ=.0039	σ_μ=.0074 σ_λ=.0030	σ_μ=.0091 σ_λ=.0032	σ_μ=.0083 σ_λ=.0034	σ_μ=.0095 σ_λ=.0049	σ_μ=.0069 σ_λ=.0050
CAMERA ON-TIME	σ_μ=.0007 σ_λ=.0017	σ_μ=.0007 σ_λ=.0016	σ_μ=.0007 σ_λ=.0018	σ_μ=.0007 σ_λ=.0017	σ_μ=.0007 σ_λ=.0017	σ_μ=.0007 σ_λ=.0019	σ_μ=.0007 σ_λ=.0017	σ_μ=.0007 σ_λ=.0019	σ_μ=.0007 σ_λ=.0017
MOON RADIUS	σ_μ=.0010 σ_λ=.0004	σ_μ=.0046 σ_λ=.0069	σ_μ=.0003 σ_λ=.0049	σ_μ=.0057 σ_λ=.0027	σ_μ=.0042 σ_λ=.0012	σ_μ=.0024 σ_λ=.0058	σ_μ=.0022 σ_λ=.0041	σ_μ=.0080 σ_λ=.0021	σ_μ=.0065 σ_λ=.0020

* μ = LATITUDE λ = LONGITUDE

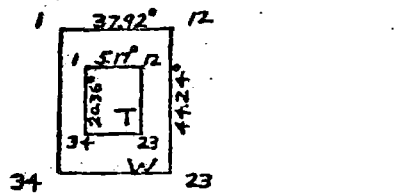
ERROR ANALYSIS RESULTS MISSION III FRAME 89





S/C ALTITUDE = 46.6 KM
TRUE ANOMALY = 354 °
INCLINATION ≈ 21 °
NOTE: ~~APOLLO TGT III PT~~ 7A
t8

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

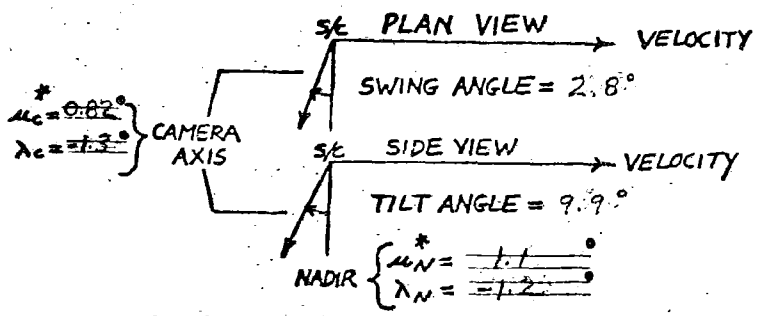
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00840° .254 KM; σ_λ = .00432° .131 KM	σ_u = .00560° .169 KM; σ_λ = .00389° .118 KM	σ_u = .00811° .246 KM; σ_λ = .00389° .118 KM	σ_u = .01174° .354 KM; σ_λ = .00449° .136 KM	σ_u = .01174° .354 KM; σ_λ = .00496° .154 KM	σ_u = .01176° .354 KM; σ_λ = .00560° .170 KM	σ_u = .00890° .263 KM; σ_λ = .00484° .146 KM	σ_u = .00620° .188 KM; σ_λ = .00447° .135 KM	σ_u = .00610° .185 KM; σ_λ = .00416° .126 KM
NAVIGATION	σ_u = .000261; σ_λ = .000557	σ_u = .000276; σ_λ = .000542	σ_u = .000262; σ_λ = .000550	σ_u = .000246; σ_λ = .000561	σ_u = .000246; σ_λ = .000567	σ_u = .000247; σ_λ = .000575	σ_u = .000261; σ_λ = .000564	σ_u = .000278; σ_λ = .000553	σ_u = .000277; σ_λ = .000547
ATTITUDE	σ_u = .00642; σ_λ = .00338	σ_u = .00511; σ_λ = .00358	σ_u = .00605; σ_λ = .00329	σ_u = .00796; σ_λ = .00324	σ_u = .00820; σ_λ = .00333	σ_u = .00849; σ_λ = .00348	σ_u = .00680; σ_λ = .00350	σ_u = .00557; σ_λ = .00379	σ_u = .00536; σ_λ = .00368
CAMERA ON-TIME	σ_u = .000431; σ_λ = .00116	σ_u = .000431; σ_λ = .00116	σ_u = .000432; σ_λ = .00116	σ_u = .000424; σ_λ = .00117	σ_u = .000424; σ_λ = .00117	σ_u = .000423; σ_λ = .00117	σ_u = .00430; σ_λ = .00119	σ_u = .000438; σ_λ = .00116	σ_u = .000439; σ_λ = .00116
MOON RADIUS	σ_u = .00539; σ_λ = .00236	σ_u = .00309; σ_λ = .000822	σ_u = .00538; σ_λ = .00165	σ_u = .00862; σ_λ = .00282	σ_u = .00839; σ_λ = .00344	σ_u = .00812; σ_λ = .00419	σ_u = .00640; σ_λ = .00309	σ_u = .00266; σ_λ = .00198	σ_u = .00286; σ_λ = .00145

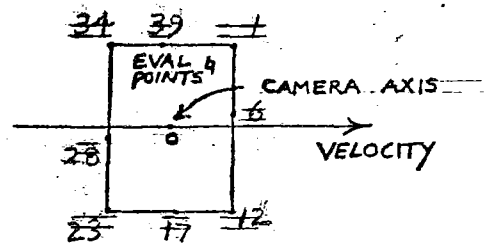
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00921° .289 KM; σ_λ = .00448° .131 KM	σ_u = .00387° .118 KM; σ_λ = .00592° .179 KM	σ_u = .00830° .254 KM; σ_λ = .00430° .131 KM	σ_u = .01715° .577 KM; σ_λ = .00540° .163 KM	σ_u = .01930° .585 KM; σ_λ = .00620° .188 KM	σ_u = .02029° .613 KM; σ_λ = .01348° .406 KM	σ_u = .01087° .328 KM; σ_λ = .00941° .285 KM	σ_u = .00743° .225 KM; σ_λ = .00745° .226 KM	σ_u = .00556° .168 KM; σ_λ = .00511° .155 KM
NAVIGATION	σ_u = .000261; σ_λ = .000557	σ_u = .000286; σ_λ = .000502	σ_u = .000256; σ_λ = .000512	σ_u = .000234; σ_λ = .000529	σ_u = .000233; σ_λ = .000580	σ_u = .000234; σ_λ = .000652	σ_u = .000262; σ_λ = .000610	σ_u = .000309; σ_λ = .000579	σ_u = .000297; σ_λ = .000541
ATTITUDE	σ_u = .00745; σ_λ = .00358	σ_u = .00345; σ_λ = .00452	σ_u = .00498; σ_λ = .00328	σ_u = .01156; σ_λ = .00522	σ_u = .01401; σ_λ = .00391	σ_u = .01701; σ_λ = .00713	σ_u = .01003; σ_λ = .00557	σ_u = .00729; σ_λ = .00586	σ_u = .00553; σ_λ = .00489
CAMERA ON-TIME	σ_u = .00043; σ_λ = .00116	σ_u = .00044; σ_λ = .00115	σ_u = .00043; σ_λ = .00115	σ_u = .00042; σ_λ = .00116	σ_u = .00041; σ_λ = .00117	σ_u = .00040; σ_λ = .00120	σ_u = .00043; σ_λ = .00119	σ_u = .00045; σ_λ = .00117	σ_u = .00044; σ_λ = .00116
MOON RADIUS	σ_u = .00539; σ_λ = .00236	σ_u = .00172; σ_λ = .00362	σ_u = .00662; σ_λ = .00245	σ_u = .0153; σ_λ = .00056	σ_u = .0133; σ_λ = .00479	σ_u = .0110; σ_λ = .0114	σ_u = .00414; σ_λ = .00747	σ_u = .00135; σ_λ = .00442	σ_u = .00006; σ_λ = .00072

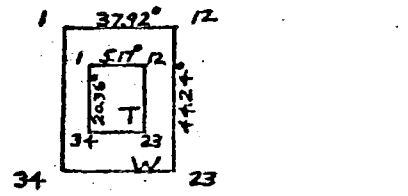
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION III FRAME 97





S/C ALTITUDE = 95.2 KM
TRUE ANOMALY = 3.65 °
INCLINATION ≈ 2.1 °
NOTE: APOLLO 16 T, W P-7B
t8



TELEPHOTO LENS, T

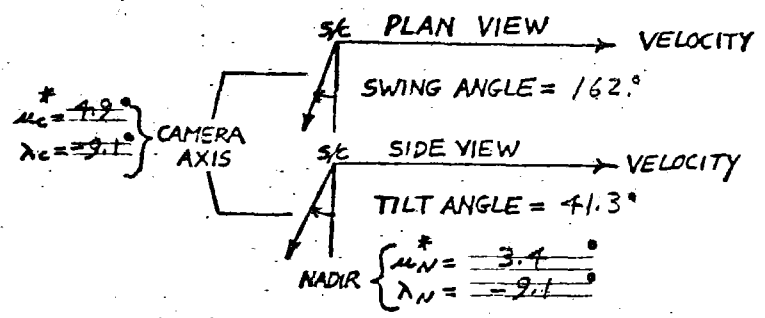
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00581° .176 KM, σ_λ = .00380° .115 KM	σ_u = .00460° .139 KM, σ_λ = .00401° .122 KM	σ_u = .00553° .167 KM, σ_λ = .00365° .111 KM	σ_u = .00775° .234 KM, σ_λ = .00379° .115 KM	σ_u = .00780° .236 KM, σ_λ = .00403° .122 KM	σ_u = .00738° .239 KM, σ_λ = .00441° .134 KM	σ_u = .00610° .185 KM, σ_λ = .00407° .123 KM	σ_u = .00511° .155 KM, σ_λ = .00417° .126 KM	σ_u = .00487° .148 KM, σ_λ = .00405° .123 KM
NAVIGATION	σ_u = .00079, σ_λ = .00198	σ_u = .00082, σ_λ = .00196	σ_u = .00079, σ_λ = .00197	σ_u = .00076, σ_λ = .00198	σ_u = .00076, σ_λ = .00199	σ_u = .00076, σ_λ = .00199	σ_u = .00079, σ_λ = .00198	σ_u = .00082, σ_λ = .00197	σ_u = .00082, σ_λ = .00196
ATTITUDE	σ_u = .00531, σ_λ = .00285	σ_u = .00450, σ_λ = .00328	σ_u = .00499, σ_λ = .00283	σ_u = .00600, σ_λ = .00269	σ_u = .00622, σ_λ = .00271	σ_u = .00649, σ_λ = .00275	σ_u = .00583, σ_λ = .00290	σ_u = .00502, σ_λ = .00341	σ_u = .00473, σ_λ = .00334
CAMERA ON-TIME	σ_u = .00044, σ_λ = .00116	σ_u = .00045, σ_λ = .00116	σ_u = .00044, σ_λ = .00116	σ_u = .00044, σ_λ = .00116	σ_u = .00044, σ_λ = .00116	σ_u = .00044, σ_λ = .00116	σ_u = .00044, σ_λ = .00116	σ_u = .00045, σ_λ = .00116	σ_u = .00045, σ_λ = .00116
MOON RADIUS	σ_u = .00219, σ_λ = .00103	σ_u = .00014, σ_λ = .00040	σ_u = .00220, σ_λ = .00037	σ_u = .00485, σ_λ = .00136	σ_u = .00463, σ_λ = .00190	σ_u = .00438, σ_λ = .00255	σ_u = .00218, σ_λ = .00169	σ_u = .00029, σ_λ = .00072	σ_u = .00009, σ_λ = .00021

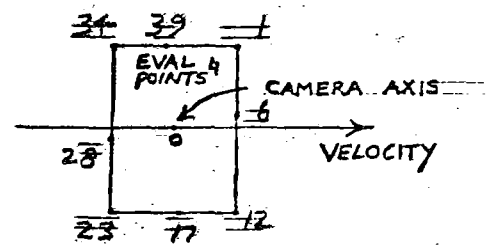
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00661° .200 KM, σ_λ = .00390° .118 KM	σ_u = .00332° .101 KM, σ_λ = .00715° .217 KM	σ_u = .00520° .158 KM, σ_λ = .00511° .155 KM	σ_u = .0123° .373 KM, σ_λ = .00528° .160 KM	σ_u = .0123° .373 KM, σ_λ = .00480° .145 KM	σ_u = .0132° .400 KM, σ_λ = .00925° .280 KM	σ_u = .00975° .265 KM, σ_λ = .00733° .222 KM	σ_u = .00824° .268 KM, σ_λ = .00671° .204 KM	σ_u = .00623° .189 KM, σ_λ = .00538° .163 KM
NAVIGATION	σ_u = .00079, σ_λ = .00198	σ_u = .00083, σ_λ = .00191	σ_u = .00078, σ_λ = .00192	σ_u = .00072, σ_λ = .00194	σ_u = .00072, σ_λ = .00200	σ_u = .00073, σ_λ = .00208	σ_u = .00080, σ_λ = .00204	σ_u = .00087, σ_λ = .00201	σ_u = .00085, σ_λ = .00196
ATTITUDE	σ_u = .00617, σ_λ = .00298	σ_u = .00296, σ_λ = .00467	σ_u = .00383, σ_λ = .00298	σ_u = .00742, σ_λ = .00452	σ_u = .00928, σ_λ = .00312	σ_u = .0117, σ_λ = .00381	σ_u = .00865, σ_λ = .00400	σ_u = .00765, σ_λ = .00538	σ_u = .00544, σ_λ = .00485
CAMERA ON-TIME	σ_u = .00044, σ_λ = .00116	σ_u = .00045, σ_λ = .00115	σ_u = .00044, σ_λ = .00116	σ_u = .00044, σ_λ = .00116	σ_u = .00043, σ_λ = .00116	σ_u = .00043, σ_λ = .00118	σ_u = .00041, σ_λ = .00117	σ_u = .00046, σ_λ = .00117	σ_u = .00045, σ_λ = .00116
MOON RADIUS	σ_u = .00219, σ_λ = .00103	σ_u = .00116, σ_λ = .00494	σ_u = .00340, σ_λ = .00350	σ_u = .00976, σ_λ = .00154	σ_u = .00810, σ_λ = .00282	σ_u = .00617, σ_λ = .00808	σ_u = .00036, σ_λ = .00567	σ_u = .00433, σ_λ = .00326	σ_u = .00287, σ_λ = .00050

* u = LATITUDE λ = LONGITUDE

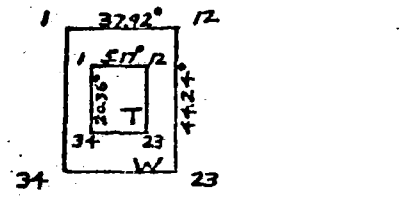
ERROR ANALYSIS RESULTS MISSION III FRAME 102





S/C ALTITUDE = 52.0 KM
TRUE ANOMALY = 342. °
INCLINATION = 21. °
NOTE:

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .01632° .495 KM; $\nabla\lambda$ = .00565° .171 KM	∇u = .02171° .660 KM; $\nabla\lambda$ = .00758° .230 KM	∇u = .01593° .483 KM; $\nabla\lambda$ = .00577° .175 KM	∇u = .01169° .355 KM; $\nabla\lambda$ = .00531° .161 KM	∇u = .01224° .371 KM; $\nabla\lambda$ = .00543° .165 KM	∇u = .01294° .392 KM; $\nabla\lambda$ = .00569° .172 KM	∇u = .01673° .506 KM; $\nabla\lambda$ = .00571° .173 KM	∇u = .02431° .738 KM; $\nabla\lambda$ = .00713° .216 KM	∇u = .02308° .700 KM; $\nabla\lambda$ = .00729° .220 KM
NAVIGATION	∇u = .00169; $\nabla\lambda$ = .00335	∇u = .00182; $\nabla\lambda$ = .00330	∇u = .00169; $\nabla\lambda$ = .00333	∇u = .00157; $\nabla\lambda$ = .00336	∇u = .00158; $\nabla\lambda$ = .00337	∇u = .00159; $\nabla\lambda$ = .00340	∇u = .00169; $\nabla\lambda$ = .00338	∇u = .00187; $\nabla\lambda$ = .00335	∇u = .00185; $\nabla\lambda$ = .00333
ATTITUDE	∇u = .01081; $\nabla\lambda$ = .00420	∇u = .01353; $\nabla\lambda$ = .00630	∇u = .01016; $\nabla\lambda$ = .00431	∇u = .00824; $\nabla\lambda$ = .00371	∇u = .00879; $\nabla\lambda$ = .00376	∇u = .00948; $\nabla\lambda$ = .00386	∇u = .01146; $\nabla\lambda$ = .00413	∇u = .01634; $\nabla\lambda$ = .00605	∇u = .01501; $\nabla\lambda$ = .00618
CAMERA ON-TIME	∇u = .00076; $\nabla\lambda$ = .00174	∇u = .00080; $\nabla\lambda$ = .00173	∇u = .00076; $\nabla\lambda$ = .00174	∇u = .00072; $\nabla\lambda$ = .00174	∇u = .00073; $\nabla\lambda$ = .00175	∇u = .00073; $\nabla\lambda$ = .00176	∇u = .00076; $\nabla\lambda$ = .00175	∇u = .00082; $\nabla\lambda$ = .00174	∇u = .00081; $\nabla\lambda$ = .00179
MOON RADIUS	∇u = .01208; $\nabla\lambda$ = .00014	∇u = .01686; $\nabla\lambda$ = .00198	∇u = .01212; $\nabla\lambda$ = .00075	∇u = .00811; $\nabla\lambda$ = .00030	∇u = .00834; $\nabla\lambda$ = .00093	∇u = .00862; $\nabla\lambda$ = .00169	∇u = .01204; $\nabla\lambda$ = .00102	∇u = .01789; $\nabla\lambda$ = .00010	∇u = .01741; $\nabla\lambda$ = .00097

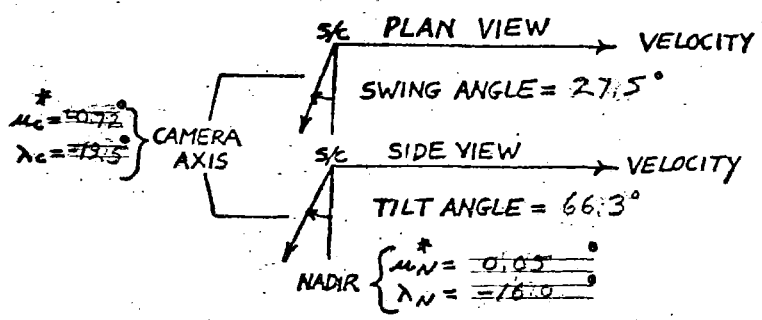
WIDE-ANGLE LENS, W

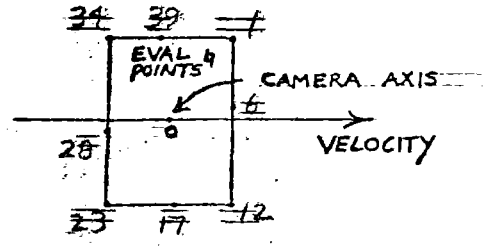
ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .01758° .532 KM; $\nabla\lambda$ = .00573° .174 KM	∇u = .02633° .795 KM; $\nabla\lambda$ = .01886° .573 KM	∇u = .01231° .368 KM; $\nabla\lambda$ = .00828° .247 KM	∇u = .00699° .212 KM; $\nabla\lambda$ = .00639° .194 KM	∇u = .01008° .305 KM; $\nabla\lambda$ = .00605° .184 KM	∇u = .01509° .458 KM; $\nabla\lambda$ = .01012° .306 KM	∇u = .02564° .780 KM; $\nabla\lambda$ = .00992° .302 KM	∇u = .08851° .269 KM; $\nabla\lambda$ = .01257° .382 KM	∇u = .04684° .142 KM; $\nabla\lambda$ = .01497° .459 KM
NAVIGATION	∇u = .00169; $\nabla\lambda$ = .00335	∇u = .00191; $\nabla\lambda$ = .00307	∇u = .00161; $\nabla\lambda$ = .00321	∇u = .00145; $\nabla\lambda$ = .00329	∇u = .00148; $\nabla\lambda$ = .00338	∇u = .00155; $\nabla\lambda$ = .00355	∇u = .00180; $\nabla\lambda$ = .00357	∇u = .00285; $\nabla\lambda$ = .00368	∇u = .00225; $\nabla\lambda$ = .00328
ATTITUDE	∇u = .01263; $\nabla\lambda$ = .00431	∇u = .01331; $\nabla\lambda$ = .01444	∇u = .00630; $\nabla\lambda$ = .00476	∇u = .00575; $\nabla\lambda$ = .00458	∇u = .00869; $\nabla\lambda$ = .00450	∇u = .01351; $\nabla\lambda$ = .00642	∇u = .02129; $\nabla\lambda$ = .00587	∇u = .07903; $\nabla\lambda$ = .00852	∇u = .03623; $\nabla\lambda$ = .01424
CAMERA ON-TIME	∇u = .00076; $\nabla\lambda$ = .00175	∇u = .00080; $\nabla\lambda$ = .00168	∇u = .00073; $\nabla\lambda$ = .00171	∇u = .00069; $\nabla\lambda$ = .00173	∇u = .00070; $\nabla\lambda$ = .00175	∇u = .00072; $\nabla\lambda$ = .00180	∇u = .00080; $\nabla\lambda$ = .00182	∇u = .00118; $\nabla\lambda$ = .00186	∇u = .00093; $\nabla\lambda$ = .00172
MOON RADIUS	∇u = .01208; $\nabla\lambda$ = .00014	∇u = .02263; $\nabla\lambda$ = .01162	∇u = .01043; $\nabla\lambda$ = .00571	∇u = .00364; $\nabla\lambda$ = .00246	∇u = .00481; $\nabla\lambda$ = .00138	∇u = .00699; $\nabla\lambda$ = .00674	∇u = .01415; $\nabla\lambda$ = .00692	∇u = .03981; $\nabla\lambda$ = .00827	∇u = .02959; $\nabla\lambda$ = .00276

* u = LATITUDE λ = LONGITUDE

UB 4802 1435 ORIG. 4-65

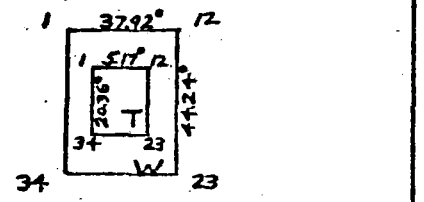
ERROR ANALYSIS RESULTS MISSION III FRAME 120





S/C ALTITUDE = 448 KM
TRUE ANOMALY = 357 °
INCLINATION ≈ 21 °
NOTE: APOLLO TGT. III S-21
R(-69°) P(-55°) Y(0°)

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

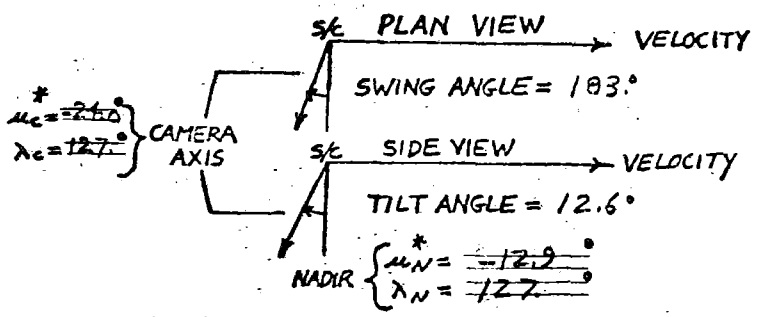
ERROR SOURCE	CAMERA AXIS (0)		EVAL POINT 1		EVAL POINT 6		EVAL POINT 12		EVAL POINT 17		EVAL POINT 23		EVAL POINT 28		EVAL POINT 34		EVAL POINT 39	
TOTAL	σ_u = .0128° .388 KM	σ_λ = .0442° 1.34 KM	σ_u = .00653° .198 KM	σ_λ = .0252° .764 KM	σ_u = .0119° .361 KM	σ_λ = .0375° 1.14 KM	σ_u = .0450° 1.36 KM	σ_λ = .116° 3.52 KM	σ_u = .0581° 1.76 KM	σ_λ = .171° 5.18 KM	σ_u = .147° 4.45 KM	σ_λ = .540° 16.4 KM	σ_u = .0140° .424 KM	σ_λ = .0537° 1.63 KM	σ_u = .00633° .192 KM	σ_λ = .0293° .888 KM	σ_u = .00636° .193 KM	σ_λ = .0273° .826 KM
NAVIGATION	σ_u = .00167	σ_λ = .00599	σ_u = .00186	σ_λ = .00525	σ_u = .00167	σ_λ = .00574	σ_u = .00061	σ_λ = .00230	σ_u = .00051	σ_λ = .0111	σ_u = .00289	σ_λ = .0230	σ_u = .00166	σ_λ = .00636	σ_u = .00191	σ_λ = .00540	σ_u = .00189	σ_λ = .00533
ATTITUDE	σ_u = .0101	σ_λ = .0236	σ_u = .00515	σ_λ = .0123	σ_u = .00874	σ_λ = .0201	σ_u = .0360	σ_λ = .0865	σ_u = .0496	σ_λ = .139	σ_u = .140	σ_λ = .509	σ_u = .0117	σ_λ = .0339	σ_u = .00574	σ_λ = .0157	σ_u = .00546	σ_λ = .0140
CAMERA ON-TIME	σ_u = .00060	σ_λ = .00207	σ_u = .00065	σ_λ = .00188	σ_u = .00061	σ_λ = .00200	σ_u = .00024	σ_λ = .00299	σ_u = .00007	σ_λ = .00372	σ_u = .00136	σ_λ = .00971	σ_u = .00060	σ_λ = .00218	σ_u = .00066	σ_λ = .00192	σ_u = .00066	σ_λ = .00190
MOON RADIUS	σ_u = .00765	σ_λ = .0355	σ_u = .00349	σ_λ = .0213	σ_u = .00790	σ_λ = .0311	σ_u = .0270	σ_λ = .0772	σ_u = .0302	σ_λ = .0983	σ_u = .0463	σ_λ = .179	σ_u = .00737	σ_λ = .0411	σ_u = .00173	σ_λ = .0241	σ_u = .00256	σ_λ = .0227

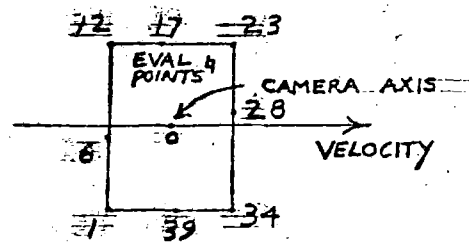
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS		EVAL POINT 1		EVAL POINT 6		EVAL POINT 12		EVAL POINT 17		EVAL POINT 23		EVAL POINT 28		EVAL POINT 34		EVAL POINT 39	
TOTAL	σ_u = .0139° .421 KM	σ_λ = .0462° 1.40 KM	σ_u = .00550° .167 KM	σ_λ = .0131° .397 KM	σ_u = .0130° .394 KM	σ_λ = .0218° .660 KM	σ_u = ND° KM	σ_λ = ND° KM	σ_u = ND° KM	σ_λ = ND° KM	σ_u = ND° KM	σ_λ = ND° KM	σ_u = ND° KM	σ_λ = ND° KM	σ_u = .0109° .330 KM	σ_λ = .0329° .995 KM	σ_u = .00466° .141 KM	σ_λ = .0201° .608 KM
NAVIGATION	σ_u = .00167	σ_λ = .00599	σ_u = .00186	σ_λ = .00481	σ_u = .00162	σ_λ = .00512	σ_u =	σ_λ =	σ_u =	σ_λ =	σ_u =	σ_λ =	σ_u =	σ_λ =	σ_u = .00226	σ_λ = .00540	σ_u = .00200	σ_λ = .00502
ATTITUDE	σ_u = .0114	σ_λ = .0289	σ_u = .00299	σ_λ = .00584	σ_u = .00555	σ_λ = .00865	σ_u =	σ_λ =	σ_u =	σ_λ =	σ_u =	σ_λ =	σ_u =	σ_λ =	σ_u = .00750	σ_λ = .0229	σ_u = .00406	σ_λ = .0113
CAMERA ON-TIME	σ_u = .00060	σ_λ = .00207	σ_u = .00066	σ_λ = .00178	σ_u = .00061	σ_λ = .00184	σ_u =	σ_λ =	σ_u =	σ_λ =	σ_u =	σ_λ =	σ_u =	σ_λ =	σ_u = .00073	σ_λ = .00192	σ_u = .00068	σ_λ = .00183
MOON RADIUS	σ_u = .00765	σ_λ = .0355	σ_u = .00417	σ_λ = .0106	σ_u = .0116	σ_λ = .0192	σ_u =	σ_λ =	σ_u =	σ_λ =	σ_u =	σ_λ =	σ_u =	σ_λ =	σ_u = .00755	σ_λ = .0230	σ_u = .00086	σ_λ = .0158

* μ = LATITUDE λ = LONGITUDE

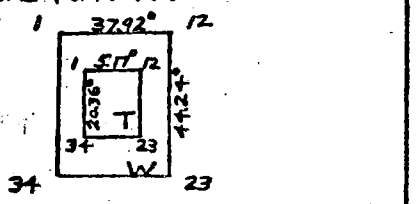
ERROR ANALYSIS RESULTS MISSION III FRAME 121





S/C ALTITUDE = 146 KM
TRUE ANOMALY = 139 °
INCLINATION ≈ 21 °
NOTE: R(169°) Y(0°) P(0°)

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .25329° 7.70 KM; σ_λ = .10654° 3.21 KM	σ_u = .36968° 11.2 KM; σ_λ = .15334° 4.65 KM	σ_u = .25359° 7.70 KM; σ_λ = .10946° 3.32 KM	σ_u = .21716° 6.60 KM; σ_λ = .10191° 3.61 KM	σ_u = .22136° 6.70 KM; σ_λ = .10177° 3.08 KM	σ_u = .22703° 6.90 KM; σ_λ = .10293° 3.12 KM	σ_u = .25422° 7.70 KM; σ_λ = .10629° 3.24 KM	σ_u = .38308° 11.6 KM; σ_λ = .14238° 4.34 KM	σ_u = .37635° 11.9 KM; σ_λ = .14358° 4.35 KM
NAVIGATION	σ_u = .00339; σ_λ = .00357	σ_u = .00410; σ_λ = .00397	σ_u = .00342; σ_λ = .00357	σ_u = .00326; σ_λ = .00335	σ_u = .00326; σ_λ = .00337	σ_u = .00326; σ_λ = .00342	σ_u = .00336; σ_λ = .00360	σ_u = .00910; σ_λ = .00912	σ_u = .00910; σ_λ = .00903
ATTITUDE	σ_u = .25320; σ_λ = .10648	σ_u = .36942; σ_λ = .15326	σ_u = .25349; σ_λ = .10958	σ_u = .21713; σ_λ = .10184	σ_u = .22133; σ_λ = .10171	σ_u = .22701; σ_λ = .10287	σ_u = .25415; σ_λ = .10621	σ_u = .38363; σ_λ = .14230	σ_u = .37609; σ_λ = .14351
CAMERA ON-TIME	σ_u = .00025; σ_λ = .00109	σ_u = .00024; σ_λ = .00122	σ_u = .00025; σ_λ = .00109	σ_u = .00028; σ_λ = .00102	σ_u = .00029; σ_λ = .00103	σ_u = .00030; σ_λ = .00104	σ_u = .00025; σ_λ = .00109	σ_u = .00021; σ_λ = .00123	σ_u = .00022; σ_λ = .00122
MOON RADIUS	σ_u = .00568; σ_λ = .00008	σ_u = .01325; σ_λ = .00212	σ_u = .00623; σ_λ = .00149	σ_u = .00099; σ_λ = .00131	σ_u = .00098; σ_λ = .00028	σ_u = .00099; σ_λ = .00094	σ_u = .00516; σ_λ = .00126	σ_u = .01311; σ_λ = .00237	σ_u = .01315; σ_λ = .00032

WIDE-ANGLE LENS, W

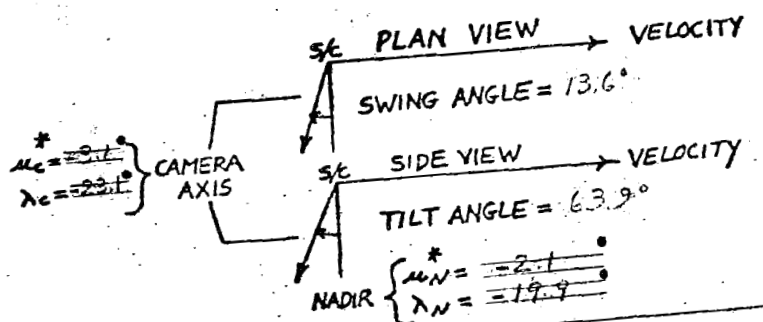
ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .27963° 8.50 KM; σ_λ = .10831° 3.30 KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = .26417° 8.00 KM; σ_λ = .21228° 6.43 KM	σ_u = .24351° 7.40 KM; σ_λ = .18845° 5.72 KM	σ_u = .25819° 7.85 KM; σ_λ = .13218° 4.00 KM	σ_u = .32950° 10.0 KM; σ_λ = .15572° 4.72 KM	σ_u = .35075° 10.6 KM; σ_λ = .18934° 5.73 KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM
NAVIGATION	σ_u = .00339; σ_λ = .00357	σ_u = ; σ_λ =	σ_u = .00350; σ_λ = .00427	σ_u = .00350; σ_λ = .00358	σ_u = .00343; σ_λ = .00326	σ_u = .00357; σ_λ = .00402	σ_u = .00331; σ_λ = .00462	σ_u = ; σ_λ =	σ_u = ; σ_λ =
ATTITUDE	σ_u = .27956; σ_λ = .10825	σ_u = ; σ_λ =	σ_u = .26904; σ_λ = .21174	σ_u = .24343; σ_λ = .18816	σ_u = .25813; σ_λ = .13213	σ_u = .32943; σ_λ = .15542	σ_u = .35071; σ_λ = .18892	σ_u = ; σ_λ =	σ_u = ; σ_λ =
CAMERA ON-TIME	σ_u = .00025; σ_λ = .00109	σ_u = ; σ_λ =	σ_u = .00026; σ_λ = .00132	σ_u = .00241; σ_λ = .00104	σ_u = .00035; σ_λ = .00098	σ_u = .00052; σ_λ = .00127	σ_u = .00028; σ_λ = .00136	σ_u = ; σ_λ =	σ_u = ; σ_λ =
MOON RADIUS	σ_u = .00568; σ_λ = .00008	σ_u = ; σ_λ =	σ_u = .00731; σ_λ = .01444	σ_u = .00522; σ_λ = .00971	σ_u = .00424; σ_λ = .00100	σ_u = .00548; σ_λ = .00879	σ_u = .00920; σ_λ = .01162	σ_u = ; σ_λ =	σ_u = ; σ_λ =

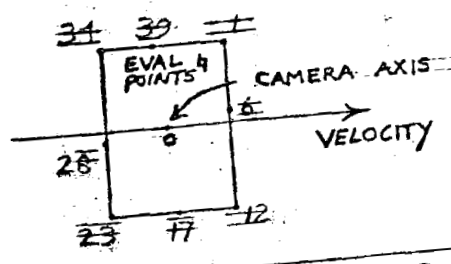
* σ_u = LATITUDE σ_λ = LONGITUDE

THE BOEING COMPANY

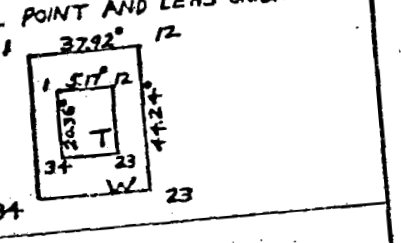
ERROR ANALYSIS RESULTS

MISSION III FRAME 136





S/C ALTITUDE = 464 KM
TRUE ANOMALY = 3.2°
INCLINATION ≈ 21°
NOTE: APOLLO TET III-5-24
R(-78°) P(-53°) Y(0°)



TELEPHOTO LENS, T

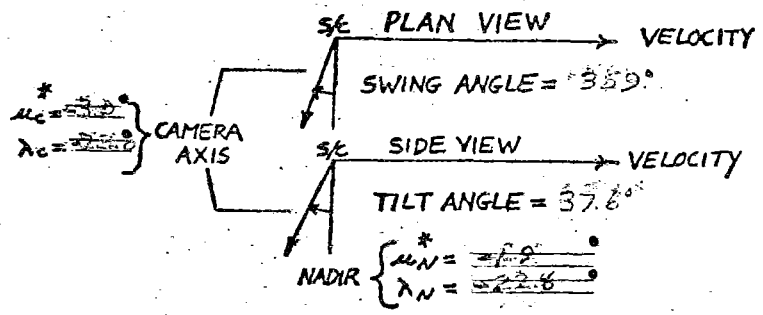
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .01374° .416 KM; $\nabla\lambda$ = .03675° 1.11 KM	∇u = .00803° .242 KM; $\nabla\lambda$ = .02150° .651 KM	∇u = .01351° .410 KM; $\nabla\lambda$ = .03254° .985 KM	∇u = .04296° 1.30 KM; $\nabla\lambda$ = .09433° 2.85 KM	∇u = .04762° 1.35 KM; $\nabla\lambda$ = .10969° 3.32 KM	∇u = .04755° 1.44 KM; $\nabla\lambda$ = .13570° 4.11 KM	∇u = .01407° .426 KM; $\nabla\lambda$ = .04205° 1.27 KM	∇u = .00699° .212 KM; $\nabla\lambda$ = .02386° .723 KM	∇u = .00742° .225 KM; $\nabla\lambda$ = .02274° .693 KM
NAVIGATION	∇u = .00094; $\nabla\lambda$ = .00380	∇u = .00095; $\nabla\lambda$ = .00345	∇u = .00094; $\nabla\lambda$ = .00370	∇u = .00114; $\nabla\lambda$ = .00531	∇u = .00115; $\nabla\lambda$ = .00566	∇u = .00116; $\nabla\lambda$ = .00625	∇u = .00074; $\nabla\lambda$ = .00391	∇u = .00096; $\nabla\lambda$ = .00349	∇u = .00096; $\nabla\lambda$ = .00347
ATTITUDE	∇u = .01007; $\nabla\lambda$ = .02115	∇u = .00541; $\nabla\lambda$ = .01064	∇u = .00922; $\nabla\lambda$ = .01758	∇u = .03434; $\nabla\lambda$ = .06971	∇u = .03707; $\nabla\lambda$ = .03482	∇u = .04106; $\nabla\lambda$ = .11049	∇u = .01101; $\nabla\lambda$ = .02579	∇u = .00559; $\nabla\lambda$ = .01271	∇u = .00550; $\nabla\lambda$ = .01172
CAMERA ON-TIME	∇u = .00063; $\nabla\lambda$ = .00188	∇u = .00066; $\nabla\lambda$ = .00178	∇u = .00064; $\nabla\lambda$ = .00135	∇u = .00042; $\nabla\lambda$ = .00238	∇u = .00040; $\nabla\lambda$ = .00252	∇u = .00037; $\nabla\lambda$ = .00277	∇u = .00063; $\nabla\lambda$ = .00192	∇u = .00066; $\nabla\lambda$ = .00179	∇u = .00066; $\nabla\lambda$ = .00179
MOON RADIUS	∇u = .00928; $\nabla\lambda$ = .02975	∇u = .00578; $\nabla\lambda$ = .01827	∇u = .00981; $\nabla\lambda$ = .02706	∇u = .02578; $\nabla\lambda$ = .06329	∇u = .02493; $\nabla\lambda$ = .06722	∇u = .02396; $\nabla\lambda$ = .07849	∇u = .00870; $\nabla\lambda$ = .03293	∇u = .00403; $\nabla\lambda$ = .01930	∇u = .00484; $\nabla\lambda$ = .01909

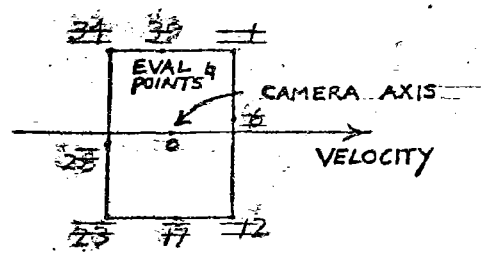
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .01463° .414 KM; $\nabla\lambda$ = .03866° 1.17 KM	∇u = .00795° .241 KM; $\nabla\lambda$ = .01151° .350 KM	∇u = .01718° .520 KM; $\nabla\lambda$ = .02178° .659 KM	∇u = ND° KM; $\nabla\lambda$ = ND° KM	∇u = ND° KM; $\nabla\lambda$ = ND° KM	∇u = ND° KM; $\nabla\lambda$ = ND° KM	∇u = .01273° .386 KM; $\nabla\lambda$ = .10119° 3.06 KM	∇u = .00648° .196 KM; $\nabla\lambda$ = .02289° .693 KM	∇u = .00448° .136 KM; $\nabla\lambda$ = .01639° .496 KM
NAVIGATION	∇u = .00094; $\nabla\lambda$ = .00380	∇u = .00096; $\nabla\lambda$ = .00326	∇u = .00094; $\nabla\lambda$ = .00347	∇u =; $\nabla\lambda$ =	∇u =; $\nabla\lambda$ =	∇u =; $\nabla\lambda$ =	∇u = .00101; $\nabla\lambda$ = .00486	∇u = .00101; $\nabla\lambda$ = .00342	∇u = .00095; $\nabla\lambda$ = .00335
ATTITUDE	∇u = .01126; $\nabla\lambda$ = .02431	∇u = .00371; $\nabla\lambda$ = .00567	∇u = .00790; $\nabla\lambda$ = .00941	∇u =; $\nabla\lambda$ =	∇u =; $\nabla\lambda$ =	∇u =; $\nabla\lambda$ =	∇u = .01257; $\nabla\lambda$ = .08545	∇u = .00532; $\nabla\lambda$ = .01532	∇u = .00394; $\nabla\lambda$ = .00946
CAMERA ON-TIME	∇u = .00063; $\nabla\lambda$ = .00188	∇u = .00067; $\nabla\lambda$ = .00174	∇u = .00065; $\nabla\lambda$ = .00177	∇u =; $\nabla\lambda$ =	∇u =; $\nabla\lambda$ =	∇u =; $\nabla\lambda$ =	∇u = .00067; $\nabla\lambda$ = .00232	∇u = .00068; $\nabla\lambda$ = .00178	∇u = .00067; $\nabla\lambda$ = .00176
MOON RADIUS	∇u = .00928; $\nabla\lambda$ = .02975	∇u = .00693; $\nabla\lambda$ = .00934	∇u = .01522; $\nabla\lambda$ = .01925	∇u =; $\nabla\lambda$ =	∇u =; $\nabla\lambda$ =	∇u =; $\nabla\lambda$ =	∇u = .00156; $\nabla\lambda$ = .05392	∇u = .00350; $\nabla\lambda$ = .01657	∇u = .00177; $\nabla\lambda$ = .01285

* u = LATITUDE λ = LONGITUDE

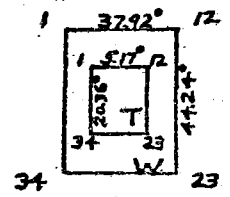
ERROR ANALYSIS RESULTS MISSION III FRAME 140





S/C ALTITUDE = 164 KM
TRUE ANOMALY = 2.3 °
INCLINATION ≈ 21 °
NOTE: APOLLO TGT III F = 9A
18

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u=.01228° .372 KM ∇_λ=.03391° 1.02 KM	∇_u=.00764° .231 KM ∇_λ=.02003° .607 KM	∇_u=.01240° .376 KM ∇_λ=.03038° .919 KM	∇_u=.03632° 1.10 KM ∇_λ=.08417° 2.55 KM	∇_u=.03465° 1.11 KM ∇_λ=.07536° 2.99 KM	∇_u=.03750° 1.14 KM ∇_λ=.11395° 3.45 KM	∇_u=.01220° .370 KM ∇_λ=.03502° 1.15 KM	∇_u=.00649° .196 KM ∇_λ=.02184° .662 KM	∇_u=.00699° .212 KM ∇_λ=.02099° .635 KM
NAVIGATION	∇_u=.00144 ∇_λ=.00227	∇_u=.00143 ∇_λ=.00207	∇_u=.00144 ∇_λ=.00221	∇_u=.00159 ∇_λ=.00317	∇_u=.00159 ∇_λ=.00337	∇_u=.00160 ∇_λ=.00372	∇_u=.00143 ∇_λ=.00233	∇_u=.00143 ∇_λ=.00209	∇_u=.00143 ∇_λ=.00208
ATTITUDE	∇_u=.00791 ∇_λ=.01584	∇_u=.00477 ∇_λ=.00756	∇_u=.00744 ∇_λ=.01353	∇_u=.02554 ∇_λ=.05536	∇_u=.02682 ∇_λ=.06544	∇_u=.02880 ∇_λ=.08250	∇_u=.00843 ∇_λ=.01882	∇_u=.00487 ∇_λ=.00889	∇_u=.00482 ∇_λ=.00849
CAMERA ON-TIME	∇_u=.00042 ∇_λ=.00125	∇_u=.00044 ∇_λ=.00119	∇_u=.00042 ∇_λ=.00123	∇_u=.00028 ∇_λ=.00158	∇_u=.00027 ∇_λ=.00168	∇_u=.00025 ∇_λ=.00185	∇_u=.00042 ∇_λ=.00128	∇_u=.00044 ∇_λ=.00119	∇_u=.00044 ∇_λ=.00119
MOON RADIUS	∇_u=.00928 ∇_λ=.02975	∇_u=.00578 ∇_λ=.01827	∇_u=.00981 ∇_λ=.02706	∇_u=.02578 ∇_λ=.05329	∇_u=.02493 ∇_λ=.06926	∇_u=.02396 ∇_λ=.07849	∇_u=.00870 ∇_λ=.03293	∇_u=.00403 ∇_λ=.01980	∇_u=.00484 ∇_λ=.01909

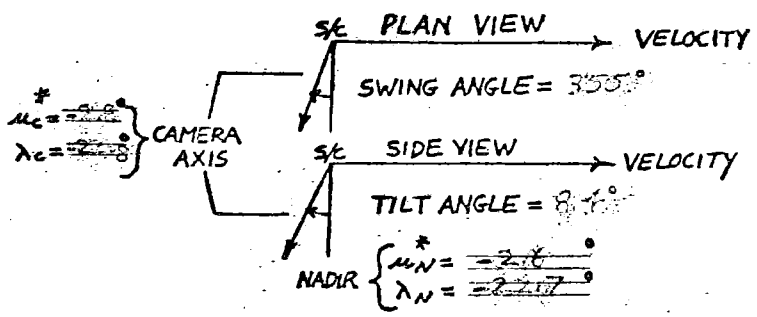
WIDE-ANGLE LENS, W

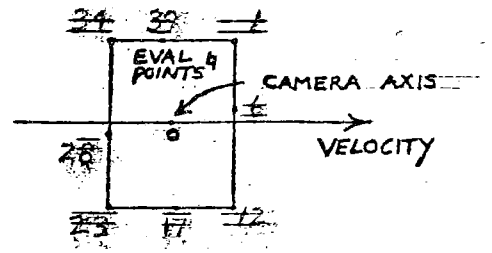
ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u=.01285° .390 KM ∇_λ=.03496° 1.06 KM	∇_u=.00785° .238 KM ∇_λ=.01066° .323 KM	∇_u=.01711° .519 KM ∇_λ=.02139° .649 KM	∇_u=ND° KM ∇_λ=ND° KM	∇_u=ND° KM ∇_λ=ND° KM	∇_u=ND° KM ∇_λ=ND° KM	∇_u=.01073° .325 KM ∇_λ=.07602° 2.30 KM	∇_u=.00588° .178 KM ∇_λ=.01900° .575 KM	∇_u=.00427° .129 KM ∇_λ=.01449° .439 KM
NAVIGATION	∇_u=.00144 ∇_λ=.00227	∇_u=.00143 ∇_λ=.00197	∇_u=.00146 ∇_λ=.00209	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u=.00143 ∇_λ=.00287	∇_u=.00144 ∇_λ=.00205	∇_u=.00143 ∇_λ=.00200
ATTITUDE	∇_u=.00576 ∇_λ=.01816	∇_u=.00338 ∇_λ=.00461	∇_u=.00767 ∇_λ=.00900	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u=.01051 ∇_λ=.05349	∇_u=.00747 ∇_λ=.00903	∇_u=.00359 ∇_λ=.00630
CAMERA ON-TIME	∇_u=.00042 ∇_λ=.00125	∇_u=.00045 ∇_λ=.00116	∇_u=.00045 ∇_λ=.00118	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u=.00048 ∇_λ=.00155	∇_u=.00045 ∇_λ=.00119	∇_u=.00045 ∇_λ=.00117
MOON RADIUS	∇_u=.00928 ∇_λ=.02975	∇_u=.00693 ∇_λ=.00734	∇_u=.01522 ∇_λ=.01925	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u=.00156 ∇_λ=.05392	∇_u=.00350 ∇_λ=.01657	∇_u=.00174 ∇_λ=.01283

* u = LATITUDE λ = LONGITUDE

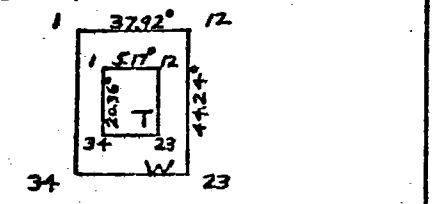
KM ATT

ERROR ANALYSIS RESULTS MISSION III FRAME 148





S/C ALTITUDE = 476 KM
TRUE ANOMALY = 4.1°
INCLINATION ≈ 24°
NOTE: APOLLO TGT TYP = 98
t8



TELEPHOTO LENS, T

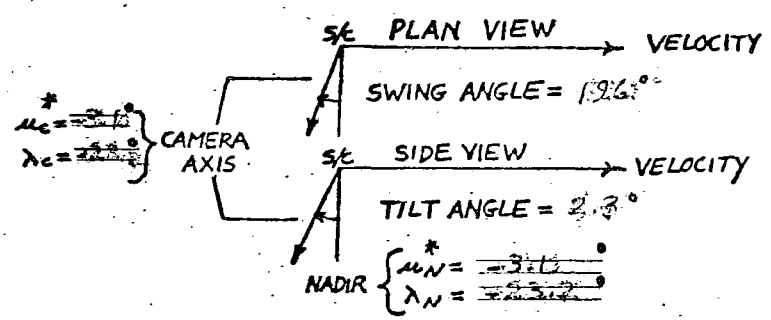
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .01308° .396 KM; $\nabla\lambda$ = .00603° .183 KM	∇u = .00934° .283 KM; $\nabla\lambda$ = .00471° .143 KM	∇u = .01278° .387 KM; $\nabla\lambda$ = .00536° .162 KM	∇u = .01921° .581 KM; $\nabla\lambda$ = .00691° .210 KM	∇u = .01909° .578 KM; $\nabla\lambda$ = .00767° .232 KM	∇u = .01895° .575 KM; $\nabla\lambda$ = .00865° .262 KM	∇u = .01341° .407 KM; $\nabla\lambda$ = .00685° .207 KM	∇u = .00919° .278 KM; $\nabla\lambda$ = .00559° .169 KM	∇u = .00926° .281 KM; $\nabla\lambda$ = .00516° .156 KM
NAVIGATION	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0
ATTITUDE	∇u = .00853; $\nabla\lambda$ = .00455	∇u = .00630; $\nabla\lambda$ = .00415	∇u = .00812; $\nabla\lambda$ = .00431	∇u = .01231; $\nabla\lambda$ = .00492	∇u = .01247; $\nabla\lambda$ = .00523	∇u = .01270; $\nabla\lambda$ = .00567	∇u = .00896; $\nabla\lambda$ = .00485	∇u = .00680; $\nabla\lambda$ = .00445	∇u = .00646; $\nabla\lambda$ = .00430
CAMERA ON-TIME	∇u = .00045; $\nabla\lambda$ = .00116	∇u = .00045; $\nabla\lambda$ = .00116	∇u = .00046; $\nabla\lambda$ = .00116	∇u = .00046; $\nabla\lambda$ = .00116	∇u = .00046; $\nabla\lambda$ = .00116	∇u = .00046; $\nabla\lambda$ = .00116	∇u = .00045; $\nabla\lambda$ = .00116	∇u = .00045; $\nabla\lambda$ = .00116	∇u = .00045; $\nabla\lambda$ = .00116
MOON RADIUS	∇u = .00991; $\nabla\lambda$ = .00381	∇u = .00688; $\nabla\lambda$ = .00191	∇u = .00986; $\nabla\lambda$ = .00276	∇u = .01474; $\nabla\lambda$ = .00471	∇u = .01443; $\nabla\lambda$ = .00549	∇u = .01407; $\nabla\lambda$ = .00643	∇u = .00997; $\nabla\lambda$ = .00469	∇u = .00639; $\nabla\lambda$ = .00318	∇u = .00661; $\nabla\lambda$ = .00260

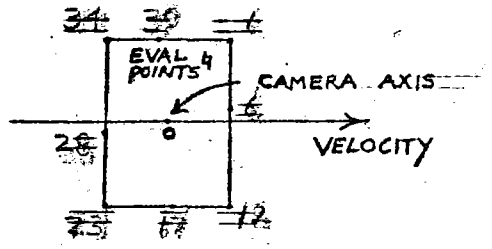
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .01405° .425 KM; $\nabla\lambda$ = .00637° .193 KM	∇u = .00703° .213 KM; $\nabla\lambda$ = .00534° .161 KM	∇u = .01377° .417 KM; $\nabla\lambda$ = .00453° .137 KM	∇u = .03786° 1.15 KM; $\nabla\lambda$ = .00613° .186 KM	∇u = .03689° 1.12 KM; $\nabla\lambda$ = .01162° .352 KM	∇u = .03676° 1.11 KM; $\nabla\lambda$ = .02640° .800 KM	∇u = .01475° .447 KM; $\nabla\lambda$ = .01309° .397 KM	∇u = .00733° .222 KM; $\nabla\lambda$ = .00827° .253 KM	∇u = .00697° .211 KM; $\nabla\lambda$ = .00528° .160 KM
NAVIGATION	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0	∇u = 0; $\nabla\lambda$ = 0
ATTITUDE	∇u = .00994; $\nabla\lambda$ = .00496	∇u = .00473; $\nabla\lambda$ = .00438	∇u = .00778; $\nabla\lambda$ = .00376	∇u = .02629; $\nabla\lambda$ = .00600	∇u = .02818; $\nabla\lambda$ = .00778	∇u = .03063; $\nabla\lambda$ = .01932	∇u = .01206; $\nabla\lambda$ = .00852	∇u = .00706; $\nabla\lambda$ = .00606	∇u = .00606; $\nabla\lambda$ = .00486
CAMERA ON-TIME	∇u = .00045; $\nabla\lambda$ = .00116	∇u = .00045; $\nabla\lambda$ = .00117	∇u = .00047; $\nabla\lambda$ = .00116	∇u = .00052; $\nabla\lambda$ = .00116	∇u = .00047; $\nabla\lambda$ = .00115	∇u = .00043; $\nabla\lambda$ = .00117	∇u = .00044; $\nabla\lambda$ = .00116	∇u = .00044; $\nabla\lambda$ = .00116	∇u = .00045; $\nabla\lambda$ = .00116
MOON RADIUS	∇u = .00991; $\nabla\lambda$ = .00381	∇u = .00518; $\nabla\lambda$ = .00283	∇u = .01135; $\nabla\lambda$ = .00187	∇u = .02723; $\nabla\lambda$ = .00045	∇u = .00238; $\nabla\lambda$ = .00837	∇u = .02032; $\nabla\lambda$ = .01796	∇u = .00548; $\nabla\lambda$ = .00987	∇u = .00194; $\nabla\lambda$ = .00551	∇u = .00341; $\nabla\lambda$ = .00171

* u = LATITUDE λ = LONGITUDE

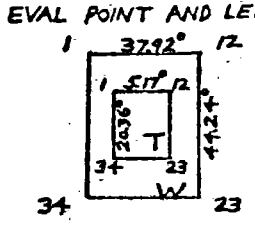
ERROR ANALYSIS RESULTS MISSION III FRAME 156





S/C ALTITUDE = 100 KM
TRUE ANOMALY = 5.6°
INCLINATION ≈ 21°
NOTE: APOLLO 7 S-I-III-P-9C

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

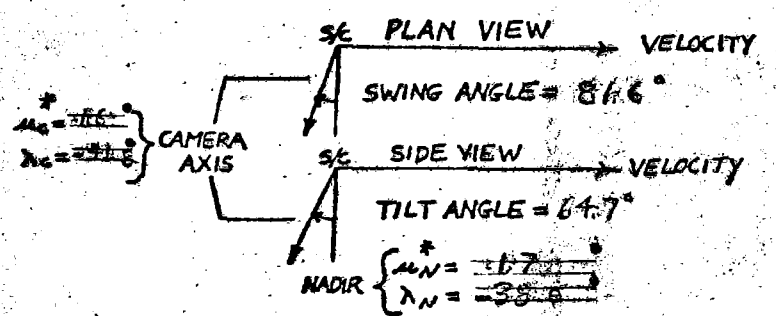
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .0057° .173 KM, σ_λ = .0037° .121 KM	σ_u = .0059° .179 KM, σ_λ = .0046° .141 KM	σ_u = .0054° .166 KM, σ_λ = .0040° .124 KM	σ_u = .0062° .190 KM, σ_λ = .0038° .116 KM	σ_u = .0063° .193 KM, σ_λ = .0038° .117 KM	σ_u = .0065° .197 KM, σ_λ = .0040° .122 KM	σ_u = .0059° .180 KM, σ_λ = .0039° .121 KM	σ_u = .0065° .198 KM, σ_λ = .0043° .133 KM	σ_u = .0062° .189 KM, σ_λ = .0044° .136 KM
NAVIGATION	σ_u = 0	σ_λ = 0	σ_u = 0	σ_λ = 0	σ_u = 0	σ_λ = 0	σ_u = 0	σ_λ = 0	σ_u = 0	σ_λ = 0	σ_u = 0	σ_λ = 0	σ_u = 0	σ_λ = 0	σ_u = 0	σ_λ = 0
ATTITUDE	σ_u = .0056°	σ_λ = .0035°	σ_u = .0053°	σ_λ = .0039°	σ_u = .0054°	σ_λ = .0035°	σ_u = .0059°	σ_λ = .0034°	σ_u = .0060°	σ_λ = .0034°	σ_u = .0062°	σ_λ = .0034°	σ_u = .0059°	σ_λ = .0035°	σ_u = .0055°	σ_λ = .0039°
CAMERA ON-TIME	σ_u = .0006°	σ_λ = .0017°	σ_u = .0006°	σ_λ = .0017°	σ_u = .0006°	σ_λ = .0017°	σ_u = .0006°	σ_λ = .0017°	σ_u = .0006°	σ_λ = .0017°	σ_u = .0006°	σ_λ = .0017°	σ_u = .0006°	σ_λ = .0017°	σ_u = .0006°	σ_λ = .0017°
MOON RADIUS	σ_u = .0004°	σ_λ = .0002°	σ_u = .0024°	σ_λ = .0017°	σ_u = .0004°	σ_λ = .0009°	σ_u = .0020°	σ_λ = .0000°	σ_u = .0018°	σ_λ = .0005°	σ_u = .0016°	σ_λ = .0011°	σ_u = .0004°	σ_λ = .0003°	σ_u = .0029°	σ_λ = .0005°	σ_u = .0027°	σ_λ = .0010°

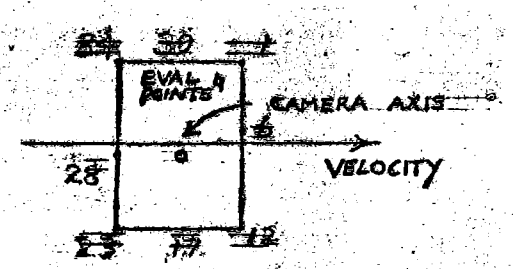
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .0066° .201 KM, σ_λ = .0040° .123 KM	σ_u = .0060° .183 KM, σ_λ = .0090° .274 KM	σ_u = .0047° .150 KM, σ_λ = .0065° .197 KM	σ_u = .0095° .288 KM, σ_λ = .0055° .167 KM	σ_u = .0094° .287 KM, σ_λ = .0041° .126 KM	σ_u = .0102° .310 KM, σ_λ = .0074° .224 KM	σ_u = .0088° .268 KM, σ_λ = .0062° .188 KM	σ_u = .0121° .368 KM, σ_λ = .0060° .182 KM	σ_u = .0092° .280 KM, σ_λ = .0059° .180 KM
NAVIGATION	σ_u = 0	σ_λ = 0	σ_u = 0	σ_λ = 0	σ_u = 0	σ_λ = 0	σ_u = 0	σ_λ = 0	σ_u = 0	σ_λ = 0	σ_u = 0	σ_λ = 0	σ_u = 0	σ_λ = 0	σ_u = 0	σ_λ = 0
ATTITUDE	σ_u = .0065°	σ_λ = .0036°	σ_u = .0045°	σ_λ = .0058°	σ_u = .0047°	σ_λ = .0040°	σ_u = .0071°	σ_λ = .0044°	σ_u = .0081°	σ_λ = .0035°	σ_u = .0097°	σ_λ = .0040°	σ_u = .0084°	σ_λ = .0041°	σ_u = .0076°	σ_λ = .0053°	σ_u = .0071°	σ_λ = .0053°
CAMERA ON-TIME	σ_u = .0006°	σ_λ = .0017°	σ_u = .0006°	σ_λ = .0017°	σ_u = .0006°	σ_λ = .0017°	σ_u = .0006°	σ_λ = .0017°	σ_u = .0006°	σ_λ = .0017°	σ_u = .0006°	σ_λ = .0017°	σ_u = .0006°	σ_λ = .0017°	σ_u = .0006°	σ_λ = .0017°
MOON RADIUS	σ_u = .0004°	σ_λ = .0002°	σ_u = .0040°	σ_λ = .0067°	σ_u = .0007°	σ_λ = .0048°	σ_u = .0063°	σ_λ = .0026°	σ_u = .0048°	σ_λ = .0012°	σ_u = .0030°	σ_λ = .0059°	σ_u = .0016°	σ_λ = .0042°	σ_u = .0073°	σ_λ = .0021°	σ_u = .0057°	σ_λ = .0018°

* μ = LATITUDE λ = LONGITUDE

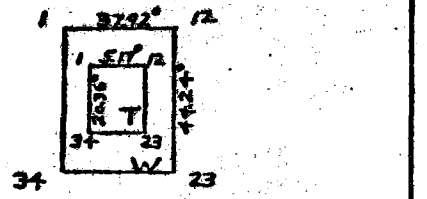
ERROR ANALYSIS RESULTS MISSION III FRAME 161





S/C ALTITUDE = 51.6 KM
TRUE ANOMALY = 352 °
INCLINATION = 21 °
NOTE: APOLLO TGT. III S-25

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

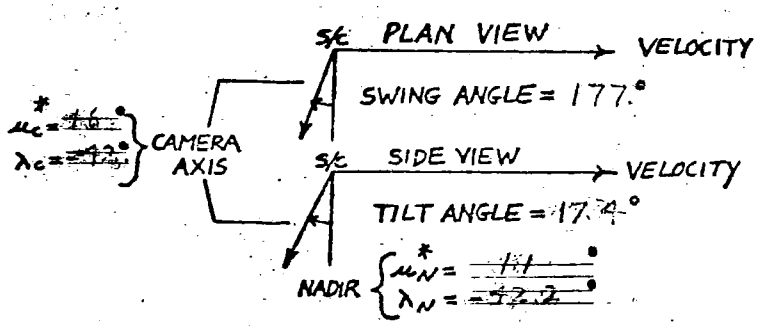
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$ = .01047° (.317 KM) $\nabla\lambda$ = .04219° (1.23 KM)	$\nabla\mu$ = .00972° (.295 KM) $\nabla\lambda$ = .03352° (1.01 KM)	$\nabla\mu$ = .00894° (.271 KM) $\nabla\lambda$ = .03527° (1.07 KM)	$\nabla\mu$ = .01207° (.365 KM) $\nabla\lambda$ = .03934° (1.19 KM)	$\nabla\mu$ = .01389° (.420 KM) $\nabla\lambda$ = .04674° (1.41 KM)	$\nabla\mu$ = .01702° (.516 KM) $\nabla\lambda$ = .06065° (1.84 KM)	$\nabla\mu$ = .01253° (.380 KM) $\nabla\lambda$ = .05255° (1.59 KM)	$\nabla\mu$ = .01327° (.401 KM) $\nabla\lambda$ = .04769° (1.45 KM)	$\nabla\mu$ = .01141° (.346 KM) $\nabla\lambda$ = .04000° (1.21 KM)
NAVIGATION	$\nabla\mu$ = .00352 $\nabla\lambda$ = .00571	$\nabla\mu$ = .00359 $\nabla\lambda$ = .00536	$\nabla\mu$ = .00352 $\nabla\lambda$ = .00544	$\nabla\mu$ = .00349 $\nabla\lambda$ = .00559	$\nabla\mu$ = .00349 $\nabla\lambda$ = .00588	$\nabla\mu$ = .00350 $\nabla\lambda$ = .00644	$\nabla\mu$ = .00352 $\nabla\lambda$ = .00613	$\nabla\mu$ = .00363 $\nabla\lambda$ = .00590	$\nabla\mu$ = .00361 $\nabla\lambda$ = .00560
ATTITUDE	$\nabla\mu$ = .00984 $\nabla\lambda$ = .02524	$\nabla\mu$ = .00751 $\nabla\lambda$ = .01934	$\nabla\mu$ = .00819 $\nabla\lambda$ = .01989	$\nabla\mu$ = .00936 $\nabla\lambda$ = .02296	$\nabla\mu$ = .01119 $\nabla\lambda$ = .02884	$\nabla\mu$ = .01426 $\nabla\lambda$ = .04047	$\nabla\mu$ = .01200 $\nabla\lambda$ = .03373	$\nabla\mu$ = .01074 $\nabla\lambda$ = .03079	$\nabla\mu$ = .00906 $\nabla\lambda$ = .02444
CAMERA ON-TIME	$\nabla\mu$ = .00065 $\nabla\lambda$ = .00222	$\nabla\mu$ = .00072 $\nabla\lambda$ = .00210	$\nabla\mu$ = .00066 $\nabla\lambda$ = .00212	$\nabla\mu$ = .00057 $\nabla\lambda$ = .00215	$\nabla\mu$ = .00055 $\nabla\lambda$ = .00226	$\nabla\mu$ = .00052 $\nabla\lambda$ = .00247	$\nabla\mu$ = .00065 $\nabla\lambda$ = .00238	$\nabla\mu$ = .00077 $\nabla\lambda$ = .00231	$\nabla\mu$ = .00074 $\nabla\lambda$ = .00219
MOON RADIUS	$\nabla\mu$ = .00032 $\nabla\lambda$ = .03323	$\nabla\mu$ = .00497 $\nabla\lambda$ = .02677	$\nabla\mu$ = .00004 $\nabla\lambda$ = .02854	$\nabla\mu$ = .00675 $\nabla\lambda$ = .03137	$\nabla\mu$ = .00742 $\nabla\lambda$ = .03624	$\nabla\mu$ = .00861 $\nabla\lambda$ = .04464	$\nabla\mu$ = .00079 $\nabla\lambda$ = .03976	$\nabla\mu$ = .00687 $\nabla\lambda$ = .03587	$\nabla\mu$ = .00588 $\nabla\lambda$ = .03109

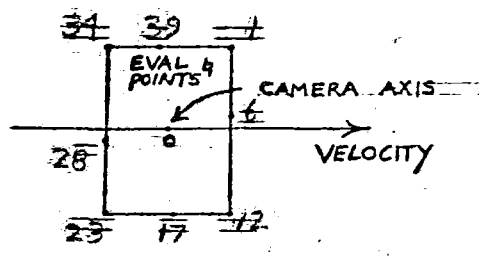
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$ = .01204° (.365 KM) $\nabla\lambda$ = .04245° (1.29 KM)	$\nabla\mu$ = .00770° (.233 KM) $\nabla\lambda$ = .01691° (.512 KM)	$\nabla\mu$ = .00482° (.146 KM) $\nabla\lambda$ = .01714° (.520 KM)	$\nabla\mu$ = .01090° (.330 KM) $\nabla\lambda$ = .02071° (.627 KM)	$\nabla\mu$ = .02296° (.695 KM) $\nabla\lambda$ = .05343° (1.62 KM)	$\nabla\mu$ = ND° KM $\nabla\lambda$ = ND° KM	$\nabla\mu$ = ND° KM $\nabla\lambda$ = ND° KM	$\nabla\mu$ = ND° KM $\nabla\lambda$ = ND° KM	$\nabla\mu$ = .01805° (.547 KM) $\nabla\lambda$ = .04420° (1.34 KM)
NAVIGATION	$\nabla\mu$ = .00352 $\nabla\lambda$ = .00571	$\nabla\mu$ = .00360 $\nabla\lambda$ = .00475	$\nabla\mu$ = .00352 $\nabla\lambda$ = .00479	$\nabla\mu$ = .00349 $\nabla\lambda$ = .00486	$\nabla\mu$ = .00358 $\nabla\lambda$ = .00601	$\nabla\mu$ = $\nabla\lambda$ =	$\nabla\mu$ = $\nabla\lambda$ =	$\nabla\mu$ = $\nabla\lambda$ =	$\nabla\mu$ = .00379 $\nabla\lambda$ = .00563
ATTITUDE	$\nabla\mu$ = .01149 $\nabla\lambda$ = .02570	$\nabla\mu$ = .00289 $\nabla\lambda$ = .00950	$\nabla\mu$ = .00321 $\nabla\lambda$ = .00799	$\nabla\mu$ = .00366 $\nabla\lambda$ = .01161	$\nabla\mu$ = .01435 $\nabla\lambda$ = .03635	$\nabla\mu$ = $\nabla\lambda$ =	$\nabla\mu$ = $\nabla\lambda$ =	$\nabla\mu$ = $\nabla\lambda$ =	$\nabla\mu$ = .01090 $\nabla\lambda$ = .03072
CAMERA ON-TIME	$\nabla\mu$ = .00065 $\nabla\lambda$ = .00222	$\nabla\mu$ = .00072 $\nabla\lambda$ = .00187	$\nabla\mu$ = .00066 $\nabla\lambda$ = .00187	$\nabla\mu$ = .00058 $\nabla\lambda$ = .00188	$\nabla\mu$ = .00042 $\nabla\lambda$ = .00228	$\nabla\mu$ = $\nabla\lambda$ =	$\nabla\mu$ = $\nabla\lambda$ =	$\nabla\mu$ = $\nabla\lambda$ =	$\nabla\mu$ = .00087 $\nabla\lambda$ = .00222
MOON RADIUS	$\nabla\mu$ = .00032 $\nabla\lambda$ = .03323	$\nabla\mu$ = .00612 $\nabla\lambda$ = .01303	$\nabla\mu$ = .00042 $\nabla\lambda$ = .01426	$\nabla\mu$ = .00963 $\nabla\lambda$ = .01634	$\nabla\mu$ = .01755 $\nabla\lambda$ = .03863	$\nabla\mu$ = $\nabla\lambda$ =	$\nabla\mu$ = $\nabla\lambda$ =	$\nabla\mu$ = $\nabla\lambda$ =	$\nabla\mu$ = .01385 $\nabla\lambda$ = .03120

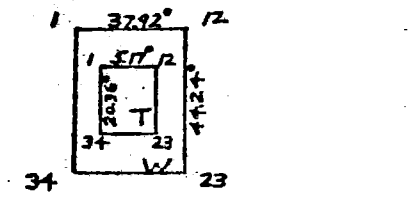
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION III FRAME 166





S/C ALTITUDE = 518 KM
TRUE ANOMALY = 353 °
INCLINATION = -21 °
NOTE: APOLLO TGT IIIP-10
t8



TELEPHOTO LENS, T

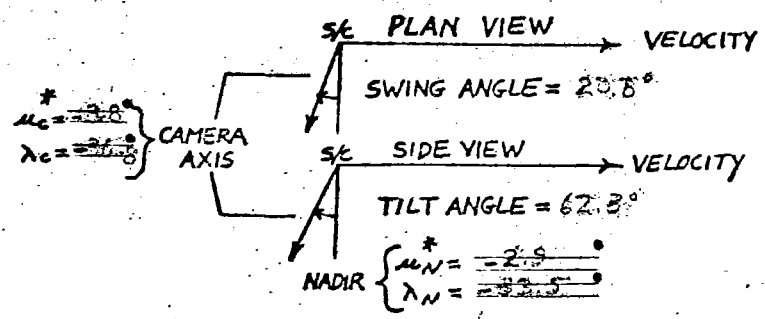
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.0063° .192 KM σ_λ=.0035° .108 KM	σ_u=.0075° .229 KM σ_λ=.0055° .168 KM	σ_u=.0058° .177 KM σ_λ=.0038° .118 KM	σ_u=.0050° .153 KM σ_λ=.0038° .116 KM	σ_u=.0055° .169 KM σ_λ=.0036° .110 KM	σ_u=.0062° .189 KM σ_λ=.0035° .107 KM	σ_u=.0068° .208 KM σ_λ=.0033° .102 KM	σ_u=.0087° .266 KM σ_λ=.0052° .159 KM	σ_u=.0082° .249 KM σ_λ=.0053° .162 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.0048° σ_λ=.0031°	σ_u=.0039° σ_λ=.0045°	σ_u=.0041° σ_λ=.0031°	σ_u=.0048° σ_λ=.0035°	σ_u=.0053° σ_λ=.0034°	σ_u=.0059° σ_λ=.0033°	σ_u=.0055° σ_λ=.0031°	σ_u=.0053° σ_λ=.0048°	σ_u=.0047° σ_λ=.0047°
CAMERA ON-TIME	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°
MOON RADIUS	σ_u=.0040° σ_λ=.0012°	σ_u=.0064° σ_λ=.0029°	σ_u=.0040° σ_λ=.0019°	σ_u=.0014° σ_λ=.0009°	σ_u=.0016° σ_λ=.0004°	σ_u=.0018° σ_λ=.0002°	σ_u=.0040° σ_λ=.0005°	σ_u=.0069° σ_λ=.0016°	σ_u=.0067° σ_λ=.0022°

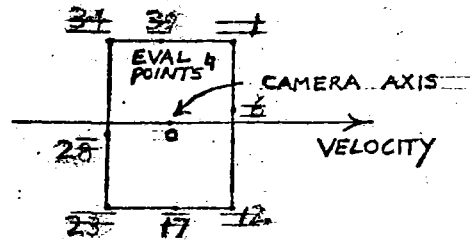
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 32
TOTAL	σ_u=.0069° .211 KM σ_λ=.0036° .110 KM	σ_u=.0091° .278 KM σ_λ=.0120° .365 KM	σ_u=.0032° .099 KM σ_λ=.0071° .218 KM	σ_u=.0043° .133 KM σ_λ=.0087° .265 KM	σ_u=.0070° .214 KM σ_λ=.0060° .183 KM	σ_u=.0119° .361 KM σ_λ=.0070° .214 KM	σ_u=.0130° .395 KM σ_λ=.0051° .157 KM	σ_u=.0195° .595 KM σ_λ=.0106° .322 KM	σ_u=.0125° .379 KM σ_λ=.0104° .319 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.0056° σ_λ=.0032°	σ_u=.0033° σ_λ=.0077°	σ_u=.0017° σ_λ=.0037°	σ_u=.0035° σ_λ=.0079°	σ_u=.0069° σ_λ=.0059°	σ_u=.0118° σ_λ=.0050°	σ_u=.0118° σ_λ=.0036°	σ_u=.0147° σ_λ=.0010°	σ_u=.0064° σ_λ=.0098°
CAMERA ON-TIME	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°	σ_u=.0004° σ_λ=.0011°
MOON RADIUS	σ_u=.0040° σ_λ=.0012°	σ_u=.0085° σ_λ=.0090°	σ_u=.0027° σ_λ=.0060°	σ_u=.0025° σ_λ=.0033°	σ_u=.0011° σ_λ=.0003°	σ_u=.0005° σ_λ=.0047°	σ_u=.0053° σ_λ=.0034°	σ_u=.0128° σ_λ=.0014°	σ_u=.0108° σ_λ=.0033°

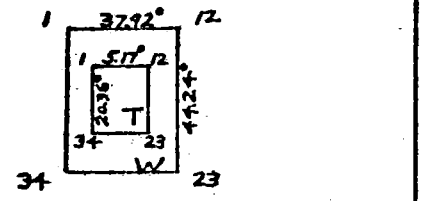
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION III FRAME 171





S/C ALTITUDE = 50.6 KM
TRUE ANOMALY = 4.5°
INCLINATION ≈ 21.°
NOTE: APOLLO 16 LM-3 S-27
R(-71°) P(-55°) Y(0°)



TELEPHOTO LENS, T

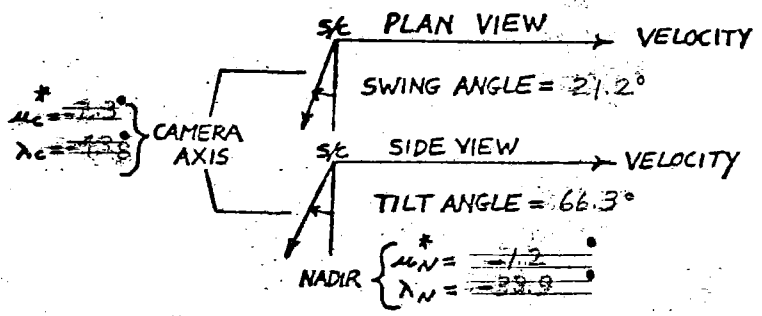
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$=.01172° .355 KM $\nabla\lambda$=.03458° 1.05 KM	$\nabla\mu$=.00659° .200 KM $\nabla\lambda$=.02088° .632 KM	$\nabla\mu$=.01128° .340 KM $\nabla\lambda$=.03033° .920 KM	$\nabla\mu$=.03062° .930 KM $\nabla\lambda$=.07026° 2.14 KM	$\nabla\mu$=.03240° .982 KM $\nabla\lambda$=.08458° 2.50 KM	$\nabla\mu$=.03532° 1.07 KM $\nabla\lambda$=.10420° 3.15 KM	$\nabla\mu$=.01232° .374 KM $\nabla\lambda$=.04004° 1.21 KM	$\nabla\mu$=.00611° .186 KM $\nabla\lambda$=.02380° .722 KM	$\nabla\mu$=.00628° .190 KM $\nabla\lambda$=.02240° .680 KM
NAVIGATION	$\nabla\mu$=0 $\nabla\lambda$=0	$\nabla\mu$=0 $\nabla\lambda$=0	$\nabla\mu$=0 $\nabla\lambda$=0	$\nabla\mu$=0 $\nabla\lambda$=0	$\nabla\mu$=0 $\nabla\lambda$=0	$\nabla\mu$=0 $\nabla\lambda$=0	$\nabla\mu$=0 $\nabla\lambda$=0	$\nabla\mu$=0 $\nabla\lambda$=0	$\nabla\mu$=0 $\nabla\lambda$=0
ATTITUDE	$\nabla\mu$=.00917 $\nabla\lambda$=.01954	$\nabla\mu$=.00513 $\nabla\lambda$=.01062	$\nabla\mu$=.00820 $\nabla\lambda$=.01602	$\nabla\mu$=.02357 $\nabla\lambda$=.04670	$\nabla\mu$=.02622 $\nabla\lambda$=.05860	$\nabla\mu$=.03012 $\nabla\lambda$=.07963	$\nabla\mu$=.01028 $\nabla\lambda$=.02426	$\nabla\mu$=.00557 $\nabla\lambda$=.01317	$\nabla\mu$=.00536 $\nabla\lambda$=.01193
CAMERA ON-TIME	$\nabla\mu$=.00064 $\nabla\lambda$=.00186	$\nabla\mu$=.00066 $\nabla\lambda$=.00177	$\nabla\mu$=.00064 $\nabla\lambda$=.00183	$\nabla\mu$=.00051 $\nabla\lambda$=.00218	$\nabla\mu$=.00049 $\nabla\lambda$=.00230	$\nabla\mu$=.00046 $\nabla\lambda$=.00252	$\nabla\mu$=.00064 $\nabla\lambda$=.00190	$\nabla\mu$=.00066 $\nabla\lambda$=.00179	$\nabla\mu$=.00066 $\nabla\lambda$=.00178
MOON RADIUS	$\nabla\mu$=.00727 $\nabla\lambda$=.02846	$\nabla\mu$=.00409 $\nabla\lambda$=.01789	$\nabla\mu$=.00772 $\nabla\lambda$=.02569	$\nabla\mu$=.01954 $\nabla\lambda$=.05245	$\nabla\mu$=.01903 $\nabla\lambda$=.05813	$\nabla\mu$=.01845 $\nabla\lambda$=.06715	$\nabla\mu$=.00676 $\nabla\lambda$=.03179	$\nabla\mu$=.00244 $\nabla\lambda$=.01974	$\nabla\mu$=.00321 $\nabla\lambda$=.01887

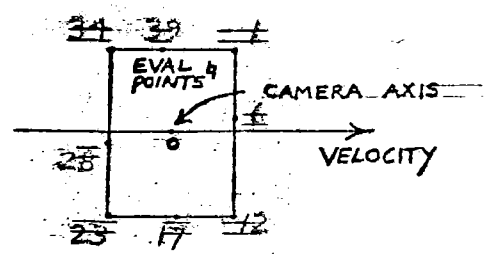
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$=.01256° .380 KM $\nabla\lambda$=.03615° 1.10 KM	$\nabla\mu$=.00624° .190 KM $\nabla\lambda$=.01076° .328 KM	$\nabla\mu$=.01344° .405 KM $\nabla\lambda$=.01902° .575 KM	$\nabla\mu$= ° KM $\nabla\lambda$= ° KM	$\nabla\mu$= ° KM $\nabla\lambda$= ° KM	$\nabla\mu$= ° KM $\nabla\lambda$= ° KM	$\nabla\mu$=.01558° .474 KM $\nabla\lambda$=.12744° 3.85 KM	$\nabla\mu$=.00844° .256 KM $\nabla\lambda$=.02575° .780 KM	$\nabla\mu$=.00422° .128 KM $\nabla\lambda$=.01668° .508 KM
NAVIGATION	$\nabla\mu$=0 $\nabla\lambda$=0	$\nabla\mu$=0 $\nabla\lambda$=0	$\nabla\mu$=0 $\nabla\lambda$=0	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$=0 $\nabla\lambda$=0	$\nabla\mu$=0 $\nabla\lambda$=0	$\nabla\mu$=0 $\nabla\lambda$=0
ATTITUDE	$\nabla\mu$=.01022 $\nabla\lambda$=.02221	$\nabla\mu$=.00358 $\nabla\lambda$=.00561	$\nabla\mu$=.00578 $\nabla\lambda$=.00775	$\nabla\mu$= N/A $\nabla\lambda$=	$\nabla\mu$= N/A $\nabla\lambda$=	$\nabla\mu$= N/A $\nabla\lambda$=	$\nabla\mu$=.01507 $\nabla\lambda$=.11131	$\nabla\mu$=.00651 $\nabla\lambda$=.01854	$\nabla\mu$=.00416 $\nabla\lambda$=.01027
CAMERA ON-TIME	$\nabla\mu$=.00064 $\nabla\lambda$=.00186	$\nabla\mu$=.00067 $\nabla\lambda$=.00174	$\nabla\mu$=.00066 $\nabla\lambda$=.00176	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$=.00072 $\nabla\lambda$=.00253	$\nabla\mu$=.00068 $\nabla\lambda$=.00179	$\nabla\mu$=.00067 $\nabla\lambda$=.00175
MOON RADIUS	$\nabla\mu$=.00727 $\nabla\lambda$=.02846	$\nabla\mu$=.00509 $\nabla\lambda$=.00902	$\nabla\mu$=.01211 $\nabla\lambda$=.01729	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$=.00387 $\nabla\lambda$=.06202	$\nabla\mu$=.00533 $\nabla\lambda$=.01778	$\nabla\mu$=.00022 $\nabla\lambda$=.01303

* μ = LATITUDE λ = LONGITUDE

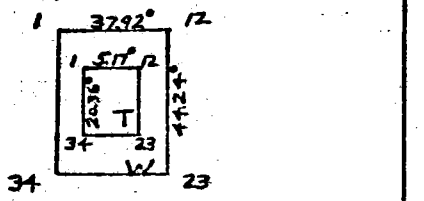
ERROR ANALYSIS RESULTS MISSION III FRAME 172





S/C ALTITUDE = 417 KM
TRUE ANOMALY = 0°
INCLINATION ≈ 41°
NOTE: APOLLO TGT III S-28
R(-74°) P(-53°) Y(0°)

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

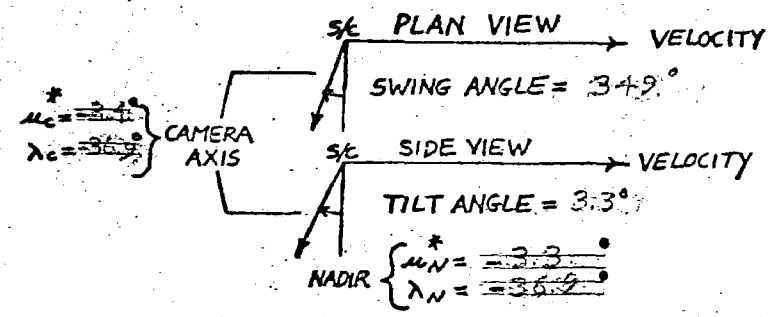
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$=.01504° .466 KM $\nabla\lambda$=.04573° 1.38 KM	$\nabla\mu$=.00756° .230 KM $\nabla\lambda$=.02479° .753 KM	$\nabla\mu$=.01406° .428 KM $\nabla\lambda$=.03872° 1.18 KM	$\nabla\mu$=.07602° 2.30 KM $\nabla\lambda$=.18724° 5.68 KM	$\nabla\mu$=.13556° 4.12 KM $\nabla\lambda$=.38959° 11.8 KM	$\nabla\mu$= ° KM $\nabla\lambda$= ° KM	$\nabla\mu$=.01639° .497 KM $\nabla\lambda$=.05562° 1.68 KM	$\nabla\mu$=.00700° .213 KM $\nabla\lambda$=.02868° .871 KM	$\nabla\mu$=.00721° .219 KM $\nabla\lambda$=.02679° .810 KM
NAVIGATION	$\nabla\mu$= 0 $\nabla\lambda$= 0	$\nabla\mu$= 0 $\nabla\lambda$= 0	$\nabla\mu$= 0 $\nabla\lambda$= 0	$\nabla\mu$= 0 $\nabla\lambda$= 0	$\nabla\mu$= 0 $\nabla\lambda$= 0	$\nabla\mu$= ° KM $\nabla\lambda$= ° KM	$\nabla\mu$= 0 $\nabla\lambda$= 0	$\nabla\mu$= 0 $\nabla\lambda$= 0	$\nabla\mu$= 0 $\nabla\lambda$= 0
ATTITUDE	$\nabla\mu$=.01170 $\nabla\lambda$=.02828	$\nabla\mu$=.00569 $\nabla\lambda$=.01304	$\nabla\mu$=.01016 $\nabla\lambda$=.02217	$\nabla\mu$=.06510 $\nabla\lambda$=.15569	$\nabla\mu$=.12557 $\nabla\lambda$=.35789	$\nabla\mu$= ND $\nabla\lambda$=	$\nabla\mu$=.01360 $\nabla\lambda$=.03722	$\nabla\mu$=.00622 $\nabla\lambda$=.01655	$\nabla\mu$=.00597 $\nabla\lambda$=.01483
CAMERA ON-TIME	$\nabla\mu$=.00059 $\nabla\lambda$=.00295	$\nabla\mu$=.00065 $\nabla\lambda$=.00185	$\nabla\mu$=.00060 $\nabla\lambda$=.00198	$\nabla\mu$=.00010 $\nabla\lambda$=.00383	$\nabla\mu$=.00097 $\nabla\lambda$=.00676	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$=.00058 $\nabla\lambda$=.00214	$\nabla\mu$=.00065 $\nabla\lambda$=.00188	$\nabla\mu$=.00065 $\nabla\lambda$=.00187
MOON RADIUS	$\nabla\mu$=.00942 $\nabla\lambda$=.03588	$\nabla\mu$=.00494 $\nabla\lambda$=.02100	$\nabla\mu$=.00970 $\nabla\lambda$=.03169	$\nabla\mu$=.03926 $\nabla\lambda$=.10395	$\nabla\mu$=.05106 $\nabla\lambda$=.15377	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$=.00913 $\nabla\lambda$=.04127	$\nabla\mu$=.00315 $\nabla\lambda$=.02335	$\nabla\mu$=.00400 $\nabla\lambda$=.02224

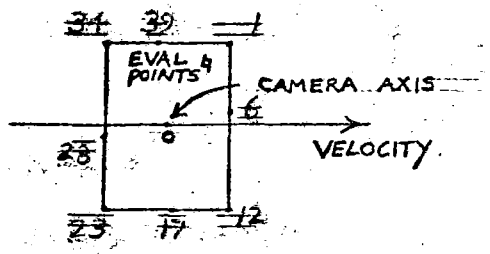
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$=.01625° .495 KM $\nabla\lambda$=.04822° 1.46 KM	$\nabla\mu$=.00677° .205 KM $\nabla\lambda$=.01228° .374 KM	$\nabla\mu$=.01548° .470 KM $\nabla\lambda$=.02256° .685 KM	$\nabla\mu$= ° KM $\nabla\lambda$= ° KM	$\nabla\mu$= ° KM $\nabla\lambda$= ° KM	$\nabla\mu$= ° KM $\nabla\lambda$= ° KM	$\nabla\mu$=.03446° 1.04 KM $\nabla\lambda$=.73093° 22.2 KM	$\nabla\mu$=.00918° .278 KM $\nabla\lambda$=.03071° .930 KM	$\nabla\mu$=.00447° .136 KM $\nabla\lambda$=.01922° .582 KM
NAVIGATION	$\nabla\mu$= 0 $\nabla\lambda$= 0	$\nabla\mu$= 0 $\nabla\lambda$= 0	$\nabla\mu$= 0 $\nabla\lambda$= 0	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$= 0 $\nabla\lambda$= 0	$\nabla\mu$= 0 $\nabla\lambda$= 0	$\nabla\mu$= 0 $\nabla\lambda$= 0
ATTITUDE	$\nabla\mu$=.01322 $\nabla\lambda$=.03216	$\nabla\mu$=.00368 $\nabla\lambda$=.00617	$\nabla\mu$=.00659 $\nabla\lambda$=.00593	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$= ND $\nabla\lambda$=	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$=.03342 $\nabla\lambda$=.70983	$\nabla\mu$=.00729 $\nabla\lambda$=.02254	$\nabla\mu$=.00439 $\nabla\lambda$=.01183
CAMERA ON-TIME	$\nabla\mu$=.00059 $\nabla\lambda$=.00205	$\nabla\mu$=.00066 $\nabla\lambda$=.00176	$\nabla\mu$=.00061 $\nabla\lambda$=.00182	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$=.00106 $\nabla\lambda$=.00964	$\nabla\mu$=.00071 $\nabla\lambda$=.00187	$\nabla\mu$=.00067 $\nabla\lambda$=.00180
MOON RADIUS	$\nabla\mu$=.00942 $\nabla\lambda$=.03588	$\nabla\mu$=.00565 $\nabla\lambda$=.01046	$\nabla\mu$=.01400 $\nabla\lambda$=.02037	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$= $\nabla\lambda$=	$\nabla\mu$=.00837 $\nabla\lambda$=.17408	$\nabla\mu$=.00554 $\nabla\lambda$=.02077	$\nabla\mu$=.00059 $\nabla\lambda$=.01509

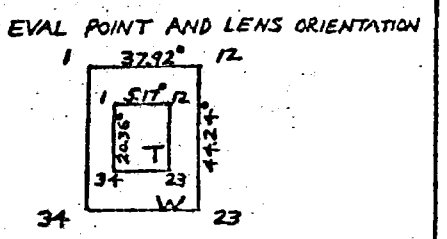
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION III FRAME 176





S/C ALTITUDE = 518 KM
TRUE ANOMALY = 50°
INCLINATION ≈ 21°
NOTE: APOLLO TGT. III P-11
t8



TELEPHOTO LENS, T

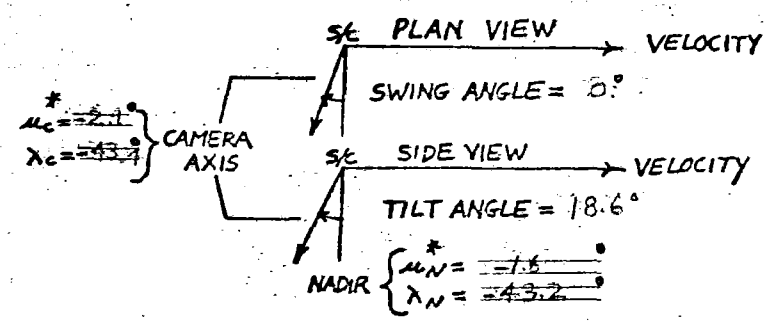
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u=.00600° .182 KM $\nabla\lambda$=.00388° .128 KM	∇u=.00558° .170 KM $\nabla\lambda$=.00437° .137 KM	∇u=.00575° .174 KM $\nabla\lambda$=.00390° .118 KM	∇u=.00722° .220 KM $\nabla\lambda$=.00378° .115 KM	∇u=.00728° .221 KM $\nabla\lambda$=.00390° .118 KM	∇u=.00736° .223 KM $\nabla\lambda$=.00414° .126 KM	∇u=.00624° .190 KM $\nabla\lambda$=.00398° .124 KM	∇u=.00613° .186 KM $\nabla\lambda$=.00423° .128 KM	∇u=.00588° .178 KM $\nabla\lambda$=.00425° .129 KM
NAVIGATION	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0
ATTITUDE	∇u=.00593 $\nabla\lambda$=.00369	∇u=.00542 $\nabla\lambda$=.00403	∇u=.00568 $\nabla\lambda$=.00369	∇u=.00639 $\nabla\lambda$=.00357	∇u=.00656 $\nabla\lambda$=.00357	∇u=.00676 $\nabla\lambda$=.00351	∇u=.00617 $\nabla\lambda$=.00371	∇u=.00589 $\nabla\lambda$=.00406	∇u=.00567 $\nabla\lambda$=.00404
CAMERA ON-TIME	∇u=.00044 $\nabla\lambda$=.00116	∇u=.00043 $\nabla\lambda$=.00116	∇u=.00044 $\nabla\lambda$=.00116	∇u=.00044 $\nabla\lambda$=.00116	∇u=.00044 $\nabla\lambda$=.00116	∇u=.00044 $\nabla\lambda$=.00116	∇u=.00044 $\nabla\lambda$=.00116	∇u=.00043 $\nabla\lambda$=.00116	∇u=.00043 $\nabla\lambda$=.00116
MOON RADIUS	∇u=.00080 $\nabla\lambda$=.00021	∇u=.00123 $\nabla\lambda$=.00121	∇u=.00082 $\nabla\lambda$=.00044	∇u=.00333 $\nabla\lambda$=.00051	∇u=.00313 $\nabla\lambda$=.00104	∇u=.00289 $\nabla\lambda$=.00167	∇u=.00079 $\nabla\lambda$=.00086	∇u=.00166 $\nabla\lambda$=.00008	∇u=.00147 $\nabla\lambda$=.00059

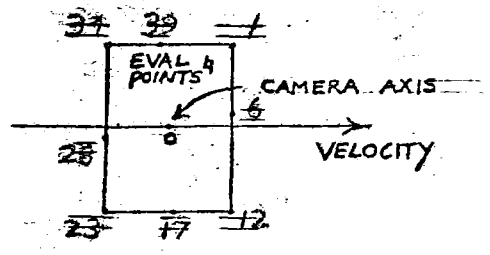
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u=.00694° .211 KM $\nabla\lambda$=.00397° .122 KM	∇u=.00523° .159 KM $\nabla\lambda$=.00831° .253 KM	∇u=.00541° .164 KM $\nabla\lambda$=.00607° .184 KM	∇u=.01129° .343 KM $\nabla\lambda$=.00539° .164 KM	∇u=.01113° .336 KM $\nabla\lambda$=.00434° .132 KM	∇u=.01166° .355 KM $\nabla\lambda$=.00817° .248 KM	∇u=.00894° .272 KM $\nabla\lambda$=.00663° .202 KM	∇u=.01089° .331 KM $\nabla\lambda$=.00609° .185 KM	∇u=.00822° .250 KM $\nabla\lambda$=.00556° .168 KM
NAVIGATION	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0
ATTITUDE	∇u=.00688 $\nabla\lambda$=.00379	∇u=.00450 $\nabla\lambda$=.00563	∇u=.00500 $\nabla\lambda$=.00409	∇u=.00807 $\nabla\lambda$=.00475	∇u=.00918 $\nabla\lambda$=.00375	∇u=.01078 $\nabla\lambda$=.00447	∇u=.00892 $\nabla\lambda$=.00448	∇u=.00917 $\nabla\lambda$=.00540	∇u=.00699 $\nabla\lambda$=.00527
CAMERA ON-TIME	∇u=.00044 $\nabla\lambda$=.00116	∇u=.00043 $\nabla\lambda$=.00118	∇u=.00044 $\nabla\lambda$=.00118	∇u=.00046 $\nabla\lambda$=.00117	∇u=.00045 $\nabla\lambda$=.00116	∇u=.00044 $\nabla\lambda$=.00115	∇u=.00043 $\nabla\lambda$=.00116	∇u=.00043 $\nabla\lambda$=.00116	∇u=.00043 $\nabla\lambda$=.00116
MOON RADIUS	∇u=.00080 $\nabla\lambda$=.00021	∇u=.00264 $\nabla\lambda$=.00600	∇u=.00212 $\nabla\lambda$=.00433	∇u=.00788 $\nabla\lambda$=.00228	∇u=.00628 $\nabla\lambda$=.00184	∇u=.00443 $\nabla\lambda$=.00674	∇u=.00041 $\nabla\lambda$=.00475	∇u=.00586 $\nabla\lambda$=.00256	∇u=.00438 $\nabla\lambda$=.00133

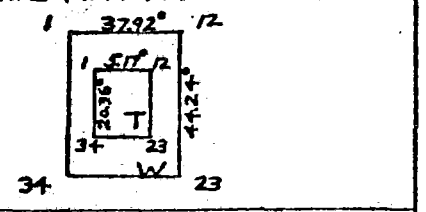
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION III FRAME 182





S/C ALTITUDE = 50.7 KM
TRUE ANOMALY = 0.26°
INCLINATION ≈ 21°
NOTE: APOLLO 16 TRP 12 B.2



TELEPHOTO LENS, T

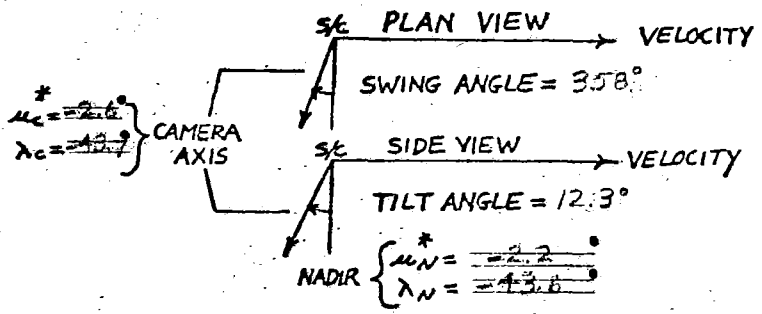
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\sqrt{u}$=.00781° .237 KM $\sqrt{\lambda}$=.00448° .136 KM	$\sqrt{u}$=.00585° .178 KM $\sqrt{\lambda}$=.00429° .130 KM	$\sqrt{u}$=.00756° .229 KM $\sqrt{\lambda}$=.00421° .128 KM	$\sqrt{u}$=.01067° .325 KM $\sqrt{\lambda}$=.00459° .139 KM	$\sqrt{u}$=.01066° .325 KM $\sqrt{\lambda}$=.00494° .149 KM	$\sqrt{u}$=.01066° .325 KM $\sqrt{\lambda}$=.00543° .165 KM	$\sqrt{u}$=.00808° .245 KM $\sqrt{\lambda}$=.00486° .178 KM	$\sqrt{u}$=.00610° .185 KM $\sqrt{\lambda}$=.00461° .140 KM	$\sqrt{u}$=.00598° .181 KM $\sqrt{\lambda}$=.00443° .134 KM
NAVIGATION	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0
ATTITUDE	$\sqrt{u}$=.00649 $\sqrt{\lambda}$=.00375	$\sqrt{u}$=.00541 $\sqrt{\lambda}$=.00391	$\sqrt{u}$=.00618 $\sqrt{\lambda}$=.00369	$\sqrt{u}$=.00777 $\sqrt{\lambda}$=.00368	$\sqrt{u}$=.00796 $\sqrt{\lambda}$=.00374	$\sqrt{u}$=.00819 $\sqrt{\lambda}$=.00385	$\sqrt{u}$=.00681 $\sqrt{\lambda}$=.00384	$\sqrt{u}$=.00583 $\sqrt{\lambda}$=.00405	$\sqrt{u}$=.00564 $\sqrt{\lambda}$=.00398
CAMERA ON-TIME	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00174	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00174	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00174	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00174	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00174	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00174	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00174	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00174	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00174
MOON RADIUS	$\sqrt{u}$=.00429 $\sqrt{\lambda}$=.00171	$\sqrt{u}$=.00212 $\sqrt{\lambda}$=.00023	$\sqrt{u}$=.00429 $\sqrt{\lambda}$=.00103	$\sqrt{u}$=.00728 $\sqrt{\lambda}$=.00212	$\sqrt{u}$=.00705 $\sqrt{\lambda}$=.00271	$\sqrt{u}$=.00679 $\sqrt{\lambda}$=.00341	$\sqrt{u}$=.00429 $\sqrt{\lambda}$=.00241	$\sqrt{u}$=.00168 $\sqrt{\lambda}$=.00136	$\sqrt{u}$=.00188 $\sqrt{\lambda}$=.00084

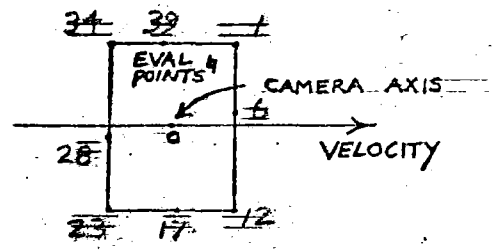
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\sqrt{u}$=.00870° .264 KM $\sqrt{\lambda}$=.00462° .140 KM	$\sqrt{u}$=.00421° .128 KM $\sqrt{\lambda}$=.00674° .205 KM	$\sqrt{u}$=.00800° .243 KM $\sqrt{\lambda}$=.00521° .158 KM	$\sqrt{u}$=.01741° .529 KM $\sqrt{\lambda}$=.00564° .171 KM	$\sqrt{u}$=.01716° .521 KM $\sqrt{\lambda}$=.00587° .178 KM	$\sqrt{u}$=.01755° .533 KM $\sqrt{\lambda}$=.01198° .364 KM	$\sqrt{u}$=.01021° .310 KM $\sqrt{\lambda}$=.00873° .265 KM	$\sqrt{u}$=.00817° .248 KM $\sqrt{\lambda}$=.00708° .215 KM	$\sqrt{u}$=.00619° .188 KM $\sqrt{\lambda}$=.00532° .162 KM
NAVIGATION	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0	$\sqrt{u}$=0 $\sqrt{\lambda}$=0
ATTITUDE	$\sqrt{u}$=.00751 $\sqrt{\lambda}$=.00393	$\sqrt{u}$=.00403 $\sqrt{\lambda}$=.00499	$\sqrt{u}$=.00544 $\sqrt{\lambda}$=.00387	$\sqrt{u}$=.01125 $\sqrt{\lambda}$=.00525	$\sqrt{u}$=.01287 $\sqrt{\lambda}$=.00406	$\sqrt{u}$=.01498 $\sqrt{\lambda}$=.00658	$\sqrt{u}$=.00972 $\sqrt{\lambda}$=.00544	$\sqrt{u}$=.00781 $\sqrt{\lambda}$=.00570	$\sqrt{u}$=.00609 $\sqrt{\lambda}$=.00502
CAMERA ON-TIME	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00174	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00175	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00175	$\sqrt{u}$=.00068 $\sqrt{\lambda}$=.00175	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00174	$\sqrt{u}$=.00065 $\sqrt{\lambda}$=.00176	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00175	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00175	$\sqrt{u}$=.00066 $\sqrt{\lambda}$=.00174
MOON RADIUS	$\sqrt{u}$=.00429 $\sqrt{\lambda}$=.00171	$\sqrt{u}$=.00079 $\sqrt{\lambda}$=.00424	$\sqrt{u}$=.00555 $\sqrt{\lambda}$=.00302	$\sqrt{u}$=.01327 $\sqrt{\lambda}$=.00109	$\sqrt{u}$=.01133 $\sqrt{\lambda}$=.00387	$\sqrt{u}$=.00914 $\sqrt{\lambda}$=.00986	$\sqrt{u}$=.00303 $\sqrt{\lambda}$=.00660	$\sqrt{u}$=.00230 $\sqrt{\lambda}$=.00382	$\sqrt{u}$=.00088 $\sqrt{\lambda}$=.00014

* u = LATITUDE λ = LONGITUDE

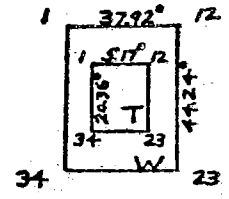
ERROR ANALYSIS RESULTS MISSION III FRAME 192





S/C ALTITUDE = 515 KM
TRUE ANOMALY = 1.8 °
INCLINATION ≈ 21 °
NOTE: APOLLO TGT. III P-12A
±16

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

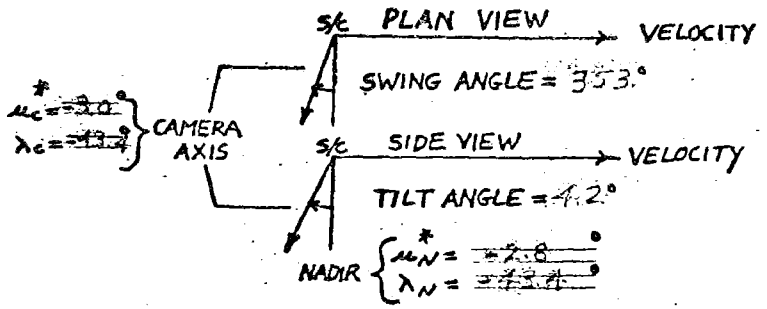
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00680° .206 KM σ_λ=.00373° .113 KM	σ_u=.00539° .163 KM σ_λ=.00388° .117 KM	σ_u=.00664° .198 KM σ_λ=.00357° .108 KM	σ_u=.00901° .276 KM σ_λ=.00372° .113 KM	σ_u=.00903° .274 KM σ_λ=.00397° .120 KM	σ_u=.00707° .275 KM σ_λ=.00441° .133 KM	σ_u=.00709° .214 KM σ_λ=.00402° .120 KM	σ_u=.00580° .176 KM σ_λ=.00404° .123 KM	σ_u=.00560° .169 KM σ_λ=.00392° .119 KM
NAVIGATION	σ_u=0° σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.00618 σ_λ=.00346	σ_u=.00532 σ_λ=.00376	σ_u=.00589 σ_λ=.00343	σ_u=.00709 σ_λ=.00333	σ_u=.00728 σ_λ=.00336	σ_u=.00750 σ_λ=.00343	σ_u=.00648 σ_λ=.00352	σ_u=.00578 σ_λ=.00387	σ_u=.00557 σ_λ=.00381
CAMERA ON-TIME	σ_u=.000340 σ_λ=.000894	σ_u=.000338 σ_λ=.000895	σ_u=.000340 σ_λ=.000895	σ_u=.000342 σ_λ=.000894	σ_u=.000341 σ_λ=.000894	σ_u=.000341 σ_λ=.000894	σ_u=.000339 σ_λ=.000894	σ_u=.000338 σ_λ=.000894	σ_u=.000338 σ_λ=.000895
MOON RADIUS	σ_u=.00282 σ_λ=.00105	σ_u=.000741 σ_λ=.000385	σ_u=.00283 σ_λ=.000388	σ_u=.00555 σ_λ=.00140	σ_u=.00534 σ_λ=.00195	σ_u=.00508 σ_λ=.00262	σ_u=.00281 σ_λ=.00192	σ_u=.000312 σ_λ=.000738	σ_u=.00507 σ_λ=.000227

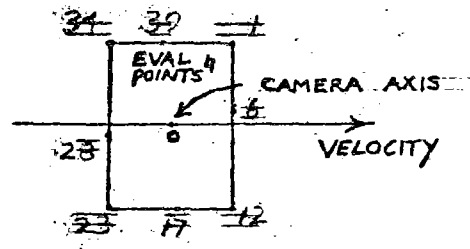
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.00772° .233 KM σ_λ=.00387° .117 KM	σ_u=.00414° .125 KM σ_λ=.00714° .216 KM	σ_u=.00651° .197 KM σ_λ=.00518° .157 KM	σ_u=.01442° .436 KM σ_λ=.00520° .157 KM	σ_u=.01427° .433 KM σ_λ=.00473° .146 KM	σ_u=.01478° .447 KM σ_λ=.00980° .296 KM	σ_u=.00953° .288 KM σ_λ=.00749° .227 KM	σ_u=.00908° .275 KM σ_λ=.00648° .196 KM	σ_u=.00692° .203 KM σ_λ=.00516° .156 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.00718 σ_λ=.00361	σ_u=.00406 σ_λ=.00508	σ_u=.00508 σ_λ=.00366	σ_u=.00956 σ_λ=.00487	σ_u=.01105 σ_λ=.00361	σ_u=.01303 σ_λ=.00505	σ_u=.00939 σ_λ=.00474	σ_u=.00829 σ_λ=.00553	σ_u=.00631 σ_λ=.00506
CAMERA ON-TIME	σ_u=.000340 σ_λ=.000894	σ_u=.000337 σ_λ=.000901	σ_u=.000343 σ_λ=.000900	σ_u=.000353 σ_λ=.000898	σ_u=.000344 σ_λ=.000894	σ_u=.000337 σ_λ=.000897	σ_u=.000338 σ_λ=.000896	σ_u=.000339 σ_λ=.000895	σ_u=.000337 σ_λ=.000895
MOON RADIUS	σ_u=.00282 σ_λ=.00105	σ_u=.000571 σ_λ=.00493	σ_u=.00405 σ_λ=.00356	σ_u=.01099 σ_λ=.00160	σ_u=.00901 σ_λ=.00293	σ_u=.00697 σ_λ=.00835	σ_u=.00158 σ_λ=.00574	σ_u=.00369 σ_λ=.00325	σ_u=.00226 σ_λ=.00180

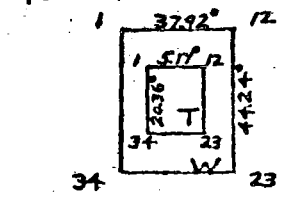
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION III FRAME 202





S/C ALTITUDE = 52.9 KM
TRUE ANOMALY =
INCLINATION =
NOTE: APOLLO TGT TRP 12 B.1



TELEPHOTO LENS, T

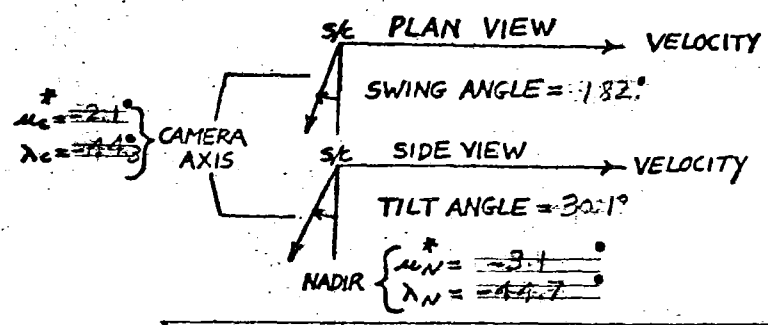
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .00819° .187 KM; $\nabla\lambda$ = .00853° .107 KM	∇u = .00860° .170 KM; $\nabla\lambda$ = .00909° .124 KM	∇u = .00591° .179 KM; $\nabla\lambda$ = .00853° .107 KM	∇u = .00752° .228 KM; $\nabla\lambda$ = .00841° .103 KM	∇u = .00760° .230 KM; $\nabla\lambda$ = .00871° .107 KM	∇u = .00771° .234 KM; $\nabla\lambda$ = .00892° .110 KM	∇u = .00647° .196 KM; $\nabla\lambda$ = .00366° .111 KM	∇u = .00619° .187 KM; $\nabla\lambda$ = .00400° .121 KM	∇u = .00593° .179 KM; $\nabla\lambda$ = .00403° .121 KM
NAVIGATION	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0
ATTITUDE	∇u = .00608 $\nabla\lambda$ = .00219	∇u = .00547 $\nabla\lambda$ = .00365	∇u = .00580 $\nabla\lambda$ = .00313	∇u = .00661 $\nabla\lambda$ = .00300	∇u = .00681 $\nabla\lambda$ = .00301	∇u = .00704 $\nabla\lambda$ = .00305	∇u = .00637 $\nabla\lambda$ = .00321	∇u = .00539 $\nabla\lambda$ = .00372	∇u = .00537 $\nabla\lambda$ = .00365
CAMERA ON-TIME	∇u = .00057 $\nabla\lambda$ = .00147	∇u = .00058 $\nabla\lambda$ = .00148	∇u = .00057 $\nabla\lambda$ = .00148	∇u = .00057 $\nabla\lambda$ = .00147	∇u = .00057 $\nabla\lambda$ = .00147	∇u = .00057 $\nabla\lambda$ = .00147	∇u = .00057 $\nabla\lambda$ = .00147	∇u = .00058 $\nabla\lambda$ = .00147	∇u = .00058 $\nabla\lambda$ = .00148
MOON RADIUS	∇u = .00100 $\nabla\lambda$ = .00031	∇u = .00104 $\nabla\lambda$ = .00112	∇u = .00131 $\nabla\lambda$ = .00037	∇u = .00357 $\nabla\lambda$ = .00362	∇u = .00334 $\nabla\lambda$ = .00115	∇u = .00315 $\nabla\lambda$ = .00142	∇u = .00059 $\nabla\lambda$ = .00395	∇u = .00147 $\nabla\lambda$ = .00001	∇u = .00127 $\nabla\lambda$ = .00057

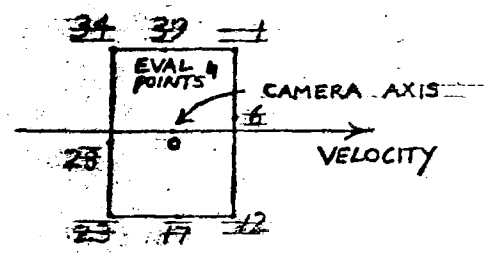
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .01217° .217 KM; $\nabla\lambda$ = .00265° .111 KM	∇u = .01478° .152 KM; $\nabla\lambda$ = .00810° .247 KM	∇u = .00141° .164 KM; $\nabla\lambda$ = .00765° .172 KM	∇u = .01128° .352 KM; $\nabla\lambda$ = .00121° .179 KM	∇u = .01179° .354 KM; $\nabla\lambda$ = .00799° .184 KM	∇u = .01185° .329 KM; $\nabla\lambda$ = .00[illegible] KM	∇u = .00841° .285 KM; $\nabla\lambda$ = .00691° .197 KM	∇u = .01128° .339 KM; $\nabla\lambda$ = .00662° .193 KM	∇u = .00814° .246 KM; $\nabla\lambda$ = .00557° .167 KM
NAVIGATION	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0
ATTITUDE	∇u = .00708 $\nabla\lambda$ = .00552	∇u = .00130 $\nabla\lambda$ = .00583	∇u = .00440 $\nabla\lambda$ = .00546	∇u = .00826 $\nabla\lambda$ = .00449	∇u = .00963 $\nabla\lambda$ = .00527	∇u = .01[illegible] $\nabla\lambda$ = .00[illegible]	∇u = .00939 $\nabla\lambda$ = .00457	∇u = .00927 $\nabla\lambda$ = .00572	∇u = .00697 $\nabla\lambda$ = .00525
CAMERA ON-TIME	∇u = .00057 $\nabla\lambda$ = .00147	∇u = .00055 $\nabla\lambda$ = .00149	∇u = .00057 $\nabla\lambda$ = .00149	∇u = .00059 $\nabla\lambda$ = .00[illegible]	∇u = .00059 $\nabla\lambda$ = .00147	∇u = .00057 $\nabla\lambda$ = .00[illegible]	∇u = .00056 $\nabla\lambda$ = .00147	∇u = .00056 $\nabla\lambda$ = .00147	∇u = .00056 $\nabla\lambda$ = .00148
MOON RADIUS	∇u = .00100 $\nabla\lambda$ = .00031	∇u = .00242 $\nabla\lambda$ = .00587	∇u = .00224 $\nabla\lambda$ = .00423	∇u = .00811 $\nabla\lambda$ = .00218	∇u = .00315 $\nabla\lambda$ = .00147	∇u = .00[illegible] $\nabla\lambda$ = .00[illegible]	∇u = .00022 $\nabla\lambda$ = .00486	∇u = .00185 $\nabla\lambda$ = .00263	∇u = .00416 $\nabla\lambda$ = .00125

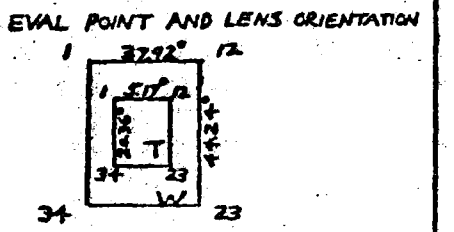
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION III FRAME 208





S/C ALTITUDE = 53.9 KM
TRUE ANOMALY = 4.7°
INCLINATION = 21°
NOTE: APOLLO TO TTP+12C
t8



TELEPHOTO LENS, T

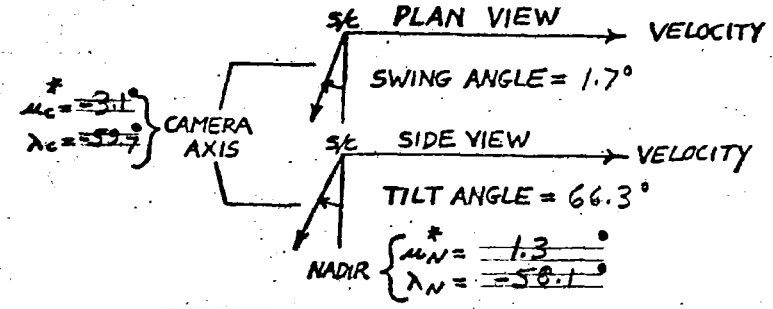
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .0102° .309 KM; $\nabla\lambda$ = .00602° .182 KM	∇u = .0127° .385 KM; $\nabla\lambda$ = .00849° .257 KM	∇u = .00979° .297 KM; $\nabla\lambda$ = .00647° .196 KM	∇u = .00771° .234 KM; $\nabla\lambda$ = .00589° .179 KM	∇u = .00825° .250 KM; $\nabla\lambda$ = .00564° .171 KM	∇u = .00892° .270 KM; $\nabla\lambda$ = .00594° .164 KM	∇u = .0107° .324 KM; $\nabla\lambda$ = .00566° .171 KM	∇u = .0141° .437 KM; $\nabla\lambda$ = .00782° .237 KM	∇u = .0136° .412 KM; $\nabla\lambda$ = .00810° .246 KM
NAVIGATION	∇u = .00199 $\nabla\lambda$ = .00364	∇u = .00202 $\nabla\lambda$ = .00364	∇u = .00199 $\nabla\lambda$ = .00364	∇u = .00198 $\nabla\lambda$ = .00365	∇u = .00197 $\nabla\lambda$ = .00365	∇u = .00198 $\nabla\lambda$ = .00365	∇u = .00199 $\nabla\lambda$ = .00365	∇u = .00202 $\nabla\lambda$ = .00364	∇u = .00202 $\nabla\lambda$ = .00364
ATTITUDE	∇u = .00689 $\nabla\lambda$ = .00364	∇u = .00693 $\nabla\lambda$ = .00573	∇u = .00615 $\nabla\lambda$ = .00321	∇u = .00608 $\nabla\lambda$ = .00376	∇u = .00602 $\nabla\lambda$ = .00365	∇u = .00729 $\nabla\lambda$ = .00512	∇u = .00762 $\nabla\lambda$ = .00358	∇u = .00987 $\nabla\lambda$ = .00588	∇u = .00793 $\nabla\lambda$ = .00582
CAMERA ON-TIME	∇u = .00043 $\nabla\lambda$ = .00116	∇u = .00042 $\nabla\lambda$ = .00117	∇u = .00043 $\nabla\lambda$ = .00116	∇u = .00043 $\nabla\lambda$ = .00116	∇u = .00043 $\nabla\lambda$ = .00116	∇u = .00043 $\nabla\lambda$ = .00116	∇u = .00043 $\nabla\lambda$ = .00116	∇u = .00042 $\nabla\lambda$ = .00116	∇u = .00042 $\nabla\lambda$ = .00116
MOON RADIUS	∇u = .00730 $\nabla\lambda$ = .00289	∇u = .0106 $\nabla\lambda$ = .00497	∇u = .00734 $\nabla\lambda$ = .00368	∇u = .00428 $\nabla\lambda$ = .00245	∇u = .00318 $\nabla\lambda$ = .00190	∇u = .00472 $\nabla\lambda$ = .00285	∇u = .00727 $\nabla\lambda$ = .00213	∇u = .0111 $\nabla\lambda$ = .00346	∇u = .0109 $\nabla\lambda$ = .00414

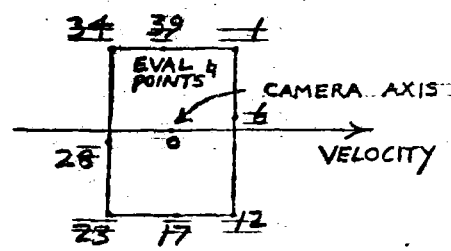
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .0110° .334 KM; $\nabla\lambda$ = .00608° .184 KM	∇u = .0151° .458 KM; $\nabla\lambda$ = .0181° .549 KM	∇u = .00477° .205 KM; $\nabla\lambda$ = .0102° .309 KM	∇u = .00494° .150 KM; $\nabla\lambda$ = .0101° .304 KM	∇u = .00817° .248 KM; $\nabla\lambda$ = .00709° .215 KM	∇u = .0132° .400 KM; $\nabla\lambda$ = .00753° .228 KM	∇u = .0176° .533 KM; $\nabla\lambda$ = .00599° .181 KM	∇u = .0344° 1.04 KM; $\nabla\lambda$ = .0125° .379 KM	∇u = .0225° .681 KM; $\nabla\lambda$ = .0152° .460 KM
NAVIGATION	∇u = .00199 $\nabla\lambda$ = .00364	∇u = .00206 $\nabla\lambda$ = .00367	∇u = .00199 $\nabla\lambda$ = .00364	∇u = .00197 $\nabla\lambda$ = .00364	∇u = .00197 $\nabla\lambda$ = .00365	∇u = .00197 $\nabla\lambda$ = .00369	∇u = .00200 $\nabla\lambda$ = .00365	∇u = .00211 $\nabla\lambda$ = .00366	∇u = .00208 $\nabla\lambda$ = .00363
ATTITUDE	∇u = .00801 $\nabla\lambda$ = .00373	∇u = .00290 $\nabla\lambda$ = .0112	∇u = .00225 $\nabla\lambda$ = .00443	∇u = .00450 $\nabla\lambda$ = .00730	∇u = .00776 $\nabla\lambda$ = .00585	∇u = .0126 $\nabla\lambda$ = .00557	∇u = .0152 $\nabla\lambda$ = .00398	∇u = .0282 $\nabla\lambda$ = .0119	∇u = .0143 $\nabla\lambda$ = .0135
CAMERA ON-TIME	∇u = .00043 $\nabla\lambda$ = .00116	∇u = .00039 $\nabla\lambda$ = .00120	∇u = .00042 $\nabla\lambda$ = .00118	∇u = .00044 $\nabla\lambda$ = .00117	∇u = .00044 $\nabla\lambda$ = .00116	∇u = .00044 $\nabla\lambda$ = .00115	∇u = .00044 $\nabla\lambda$ = .00115	∇u = .00043 $\nabla\lambda$ = .00116	∇u = .00041 $\nabla\lambda$ = .00117
MOON RADIUS	∇u = .00730 $\nabla\lambda$ = .00289	∇u = .0147 $\nabla\lambda$ = .0136	∇u = .00606 $\nabla\lambda$ = .00840	∇u = .00016 $\nabla\lambda$ = .00491	∇u = .00154 $\nabla\lambda$ = .00115	∇u = .00319 $\nabla\lambda$ = .00328	∇u = .00855 $\nabla\lambda$ = .00224	∇u = .0196 $\nabla\lambda$ = .00336	∇u = .0172 $\nabla\lambda$ = .00591

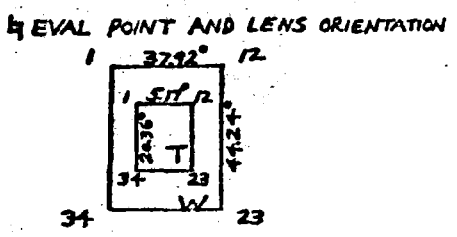
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION III FRAME 213





S/C ALTITUDE = 56.9 KM
TRUE ANOMALY = 352. °
INCLINATION ≈ 21. °
NOTE:



TELEPHOTO LENS, T

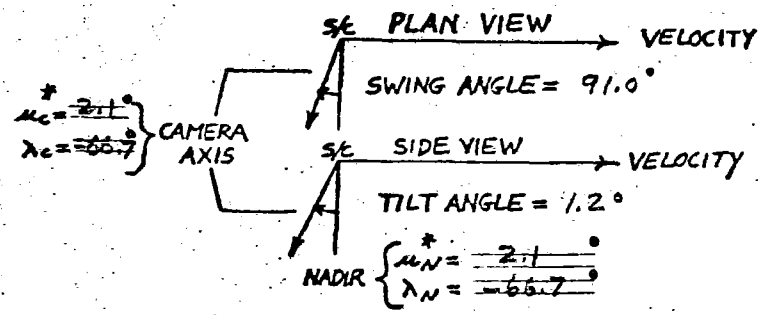
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$ = .06574° (.499 KM), $\nabla\lambda$ = .02717° (.845 KM)	$\nabla\mu$ = .03059° (.960 KM), $\nabla\lambda$ = .01379° (.415 KM)	$\nabla\mu$ = .05887° (1.78 KM), $\nabla\lambda$ = .02201° (.670 KM)	$\nabla\mu$ = 0° KM, $\nabla\lambda$ = 0° KM	$\nabla\mu$ = 0° KM, $\nabla\lambda$ = 0° KM	$\nabla\mu$ = 0° KM, $\nabla\lambda$ = 0° KM	$\nabla\mu$ = .07433° (2.25 KM), $\nabla\lambda$ = .03389° (1.03 KM)	$\nabla\mu$ = .03119° (.946 KM), $\nabla\lambda$ = .01695° (.525 KM)	$\nabla\mu$ = .03091° (.935 KM), $\nabla\lambda$ = .01545° (.470 KM)
NAVIGATION	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0
ATTITUDE	$\nabla\mu$ = .05551, $\nabla\lambda$ = .02342	$\nabla\mu$ = .02254, $\nabla\lambda$ = .01180	$\nabla\mu$ = .04839, $\nabla\lambda$ = .01891	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = .06431, $\nabla\lambda$ = .02951	$\nabla\mu$ = .02394, $\nabla\lambda$ = .01414	$\nabla\mu$ = .02330, $\nabla\lambda$ = .01201
CAMERA ON-TIME	$\nabla\mu$ = .00050, $\nabla\lambda$ = .00180	$\nabla\mu$ = .00058, $\nabla\lambda$ = .00176	$\nabla\mu$ = .00053, $\nabla\lambda$ = .00178	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = .00047, $\nabla\lambda$ = .00182	$\nabla\mu$ = .00057, $\nabla\lambda$ = .00178	$\nabla\mu$ = .00057, $\nabla\lambda$ = .00177
MOON RADIUS	$\nabla\mu$ = .03523, $\nabla\lambda$ = .01365	$\nabla\mu$ = .02067, $\nabla\lambda$ = .00692	$\nabla\mu$ = .03353, $\nabla\lambda$ = .01113	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = .03727, $\nabla\lambda$ = .01656	$\nabla\mu$ = .01999, $\nabla\lambda$ = .00916	$\nabla\mu$ = .02030, $\nabla\lambda$ = .00814

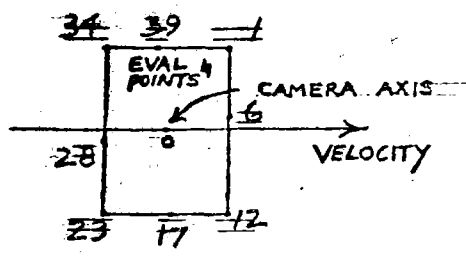
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$ = .07288° (2.16 KM), $\nabla\lambda$ = .02979° (.902 KM)	$\nabla\mu$ = .01829° (.553 KM), $\nabla\lambda$ = .00820° (.249 KM)	$\nabla\mu$ = .05226° (1.59 KM), $\nabla\lambda$ = .00996° (.302 KM)	$\nabla\mu$ = 0° KM, $\nabla\lambda$ = 0° KM	$\nabla\mu$ = 0° KM, $\nabla\lambda$ = 0° KM	$\nabla\mu$ = 0° KM, $\nabla\lambda$ = 0° KM	$\nabla\mu$ = .12025° (3.65 KM), $\nabla\lambda$ = .09989° (3.02 KM)	$\nabla\mu$ = .02030° (.603 KM), $\nabla\lambda$ = .02128° (.608 KM)	$\nabla\mu$ = .01910° (.579 KM), $\nabla\lambda$ = .01291° (.390 KM)
NAVIGATION	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0
ATTITUDE	$\nabla\mu$ = .06380, $\nabla\lambda$ = .02641	$\nabla\mu$ = .01094, $\nabla\lambda$ = .00798	$\nabla\mu$ = .03892, $\nabla\lambda$ = .00981	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = .11359, $\nabla\lambda$ = .09365	$\nabla\mu$ = .01723, $\nabla\lambda$ = .01799	$\nabla\mu$ = .01446, $\nabla\lambda$ = .01146
CAMERA ON-TIME	$\nabla\mu$ = .00050, $\nabla\lambda$ = .00180	$\nabla\mu$ = .00063, $\nabla\lambda$ = .00173	$\nabla\mu$ = .00064, $\nabla\lambda$ = .00173	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = .00027, $\nabla\lambda$ = .00209	$\nabla\mu$ = .00059, $\nabla\lambda$ = .00181	$\nabla\mu$ = .00061, $\nabla\lambda$ = .00176
MOON RADIUS	$\nabla\mu$ = .03523, $\nabla\lambda$ = .01365	$\nabla\mu$ = .01465, $\nabla\lambda$ = .00066	$\nabla\mu$ = .03487, $\nabla\lambda$ = .00017	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = 0, $\nabla\lambda$ = 0	$\nabla\mu$ = .03944, $\nabla\lambda$ = .03467	$\nabla\mu$ = .01072, $\nabla\lambda$ = .01124	$\nabla\mu$ = .01247, $\nabla\lambda$ = .00568

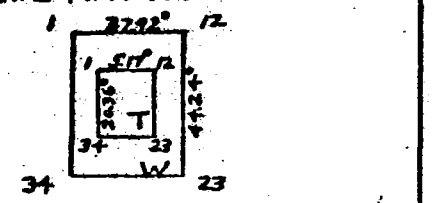
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION III FRAME 215





S/C ALTITUDE = 62.5 KM
TRUE ANOMALY = 349. °
INCLINATION ≈ 21. °
NOTE:



TELEPHOTO LENS, T

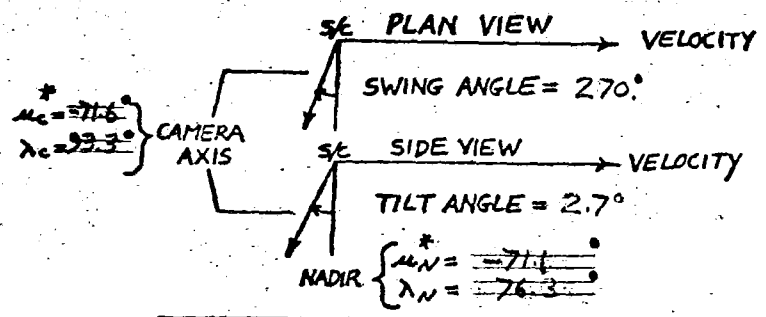
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\sqrt{u}$=.00829° .251 KM $\sqrt{\lambda}$=.00541° .164 KM	$\sqrt{u}$=.00770° .233 KM $\sqrt{\lambda}$=.00641° .194 KM	$\sqrt{u}$=.00780° .236 KM $\sqrt{\lambda}$=.00540° .164 KM	$\sqrt{u}$=.00895° .271 KM $\sqrt{\lambda}$=.00577° .174 KM	$\sqrt{u}$=.00931° .282 KM $\sqrt{\lambda}$=.00577° .174 KM	$\sqrt{u}$=.00978° .296 KM $\sqrt{\lambda}$=.00586° .177 KM	$\sqrt{u}$=.00882° .267 KM $\sqrt{\lambda}$=.00551° .167 KM	$\sqrt{u}$=.00869° .263 KM $\sqrt{\lambda}$=.00658° .199 KM	$\sqrt{u}$=.00819° .248 KM $\sqrt{\lambda}$=.00647° .196 KM
NAVIGATION	$\sqrt{u}$=.00599° $\sqrt{\lambda}$=.00357°	$\sqrt{u}$=.00602° $\sqrt{\lambda}$=.00354°	$\sqrt{u}$=.00599° $\sqrt{\lambda}$=.00355°	$\sqrt{u}$=.00596° $\sqrt{\lambda}$=.00357°	$\sqrt{u}$=.00596° $\sqrt{\lambda}$=.00358°	$\sqrt{u}$=.00597° $\sqrt{\lambda}$=.00359°	$\sqrt{u}$=.00599° $\sqrt{\lambda}$=.00358°	$\sqrt{u}$=.00603° $\sqrt{\lambda}$=.00356°	$\sqrt{u}$=.00603° $\sqrt{\lambda}$=.00355°
ATTITUDE	$\sqrt{u}$=.00569° $\sqrt{\lambda}$=.00367°	$\sqrt{u}$=.00924° $\sqrt{\lambda}$=.00994°	$\sqrt{u}$=.00496° $\sqrt{\lambda}$=.00366°	$\sqrt{u}$=.00619° $\sqrt{\lambda}$=.00414°	$\sqrt{u}$=.00677° $\sqrt{\lambda}$=.00402°	$\sqrt{u}$=.00977° $\sqrt{\lambda}$=.00391°	$\sqrt{u}$=.00643° $\sqrt{\lambda}$=.00369°	$\sqrt{u}$=.00557° $\sqrt{\lambda}$=.00526°	$\sqrt{u}$=.00595° $\sqrt{\lambda}$=.00570°
CAMERA ON-TIME	$\sqrt{u}$=.00066° $\sqrt{\lambda}$=.00173°	$\sqrt{u}$=.00067° $\sqrt{\lambda}$=.00173°	$\sqrt{u}$=.00066° $\sqrt{\lambda}$=.00173°	$\sqrt{u}$=.00064° $\sqrt{\lambda}$=.00174°	$\sqrt{u}$=.00064° $\sqrt{\lambda}$=.00174°	$\sqrt{u}$=.00064° $\sqrt{\lambda}$=.00174°	$\sqrt{u}$=.00066° $\sqrt{\lambda}$=.00174°	$\sqrt{u}$=.00067° $\sqrt{\lambda}$=.00173°	$\sqrt{u}$=.00067° $\sqrt{\lambda}$=.00173°
MOON RADIUS	$\sqrt{u}$=.00010° $\sqrt{\lambda}$=.00034°	$\sqrt{u}$=.00216° $\sqrt{\lambda}$=.00110°	$\sqrt{u}$=.00009° $\sqrt{\lambda}$=.00032°	$\sqrt{u}$=.00241° $\sqrt{\lambda}$=.00062°	$\sqrt{u}$=.00221° $\sqrt{\lambda}$=.00114°	$\sqrt{u}$=.00198° $\sqrt{\lambda}$=.00177°	$\sqrt{u}$=.00011° $\sqrt{\lambda}$=.00099°	$\sqrt{u}$=.00260° $\sqrt{\lambda}$=.00005°	$\sqrt{u}$=.00240° $\sqrt{\lambda}$=.00047°

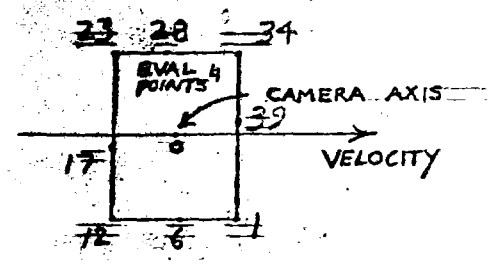
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\sqrt{u}$=.00894° .271 KM $\sqrt{\lambda}$=.00548° .166 KM	$\sqrt{u}$=.00755° .228 KM $\sqrt{\lambda}$=.01071° .324 KM	$\sqrt{u}$=.00642° .194 KM $\sqrt{\lambda}$=.00704° .214 KM	$\sqrt{u}$=.01035° .314 KM $\sqrt{\lambda}$=.01074° .325 KM	$\sqrt{u}$=.01257° .381 KM $\sqrt{\lambda}$=.00839° .254 KM	$\sqrt{u}$=.01741° .528 KM $\sqrt{\lambda}$=.00955° .289 KM	$\sqrt{u}$=.01436° .435 KM $\sqrt{\lambda}$=.00808° .245 KM	$\sqrt{u}$=.01496° .453 KM $\sqrt{\lambda}$=.01191° .360 KM	$\sqrt{u}$=.00990° .300 KM $\sqrt{\lambda}$=.01030° .311 KM
NAVIGATION	$\sqrt{u}$=.00599° $\sqrt{\lambda}$=.00357°	$\sqrt{u}$=.00604° $\sqrt{\lambda}$=.00346°	$\sqrt{u}$=.00598° $\sqrt{\lambda}$=.00350°	$\sqrt{u}$=.00596° $\sqrt{\lambda}$=.00353°	$\sqrt{u}$=.00595° $\sqrt{\lambda}$=.00359°	$\sqrt{u}$=.00595° $\sqrt{\lambda}$=.00369°	$\sqrt{u}$=.00601° $\sqrt{\lambda}$=.00367°	$\sqrt{u}$=.00619° $\sqrt{\lambda}$=.00363°	$\sqrt{u}$=.00609° $\sqrt{\lambda}$=.00359°
ATTITUDE	$\sqrt{u}$=.00660° $\sqrt{\lambda}$=.00377°	$\sqrt{u}$=.00261° $\sqrt{\lambda}$=.00800°	$\sqrt{u}$=.00197° $\sqrt{\lambda}$=.00911°	$\sqrt{u}$=.00509° $\sqrt{\lambda}$=.00977°	$\sqrt{u}$=.00972° $\sqrt{\lambda}$=.00713°	$\sqrt{u}$=.01597° $\sqrt{\lambda}$=.00533°	$\sqrt{u}$=.01296° $\sqrt{\lambda}$=.00492°	$\sqrt{u}$=.01166° $\sqrt{\lambda}$=.01065°	$\sqrt{u}$=.00556° $\sqrt{\lambda}$=.00944°
CAMERA ON-TIME	$\sqrt{u}$=.00066° $\sqrt{\lambda}$=.00173°	$\sqrt{u}$=.00067° $\sqrt{\lambda}$=.00170°	$\sqrt{u}$=.00065° $\sqrt{\lambda}$=.00171°	$\sqrt{u}$=.00062° $\sqrt{\lambda}$=.00172°	$\sqrt{u}$=.00062° $\sqrt{\lambda}$=.00174°	$\sqrt{u}$=.00063° $\sqrt{\lambda}$=.00179°	$\sqrt{u}$=.00067° $\sqrt{\lambda}$=.00177°	$\sqrt{u}$=.00071° $\sqrt{\lambda}$=.00176°	$\sqrt{u}$=.00069° $\sqrt{\lambda}$=.00172°
MOON RADIUS	$\sqrt{u}$=.00010° $\sqrt{\lambda}$=.00034°	$\sqrt{u}$=.00362° $\sqrt{\lambda}$=.00598°	$\sqrt{u}$=.00109° $\sqrt{\lambda}$=.00418°	$\sqrt{u}$=.00673° $\sqrt{\lambda}$=.00210°	$\sqrt{u}$=.00525° $\sqrt{\lambda}$=.00190°	$\sqrt{u}$=.00351° $\sqrt{\lambda}$=.00679°	$\sqrt{u}$=.00130° $\sqrt{\lambda}$=.00495°	$\sqrt{u}$=.00709° $\sqrt{\lambda}$=.00282°	$\sqrt{u}$=.00544° $\sqrt{\lambda}$=.00123°

* u = LATITUDE λ = LONGITUDE

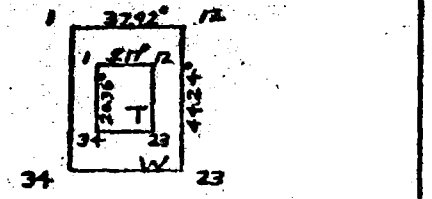
ERROR ANALYSIS RESULTS MISSION IV FRAME 6





S/C ALTITUDE = 3500 KM
TRUE ANOMALY = 207°
INCLINATION ≈ 85°
NOTE: 1ST OF SERIES

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

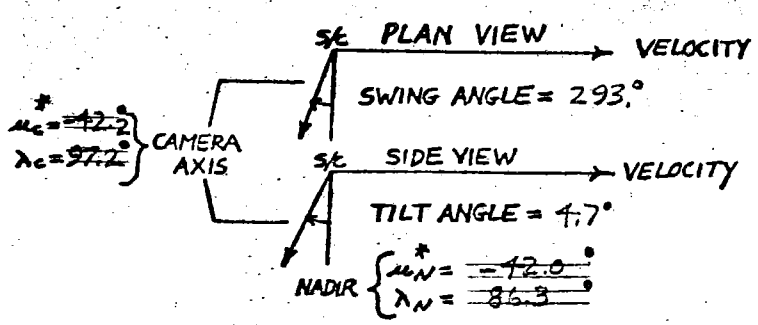
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.40173° 12.6 KM σ_λ=.67393° 20.4 KM	σ_u=.50543° 15.3 KM σ_λ=.29766° 9.03 KM	σ_u=.36469° 11.1 KM σ_λ=.67455° 20.5 KM	σ_u=.46700° 14.2 KM σ_λ=2.5320° 76.8 KM	σ_u=.54071° 16.4 KM σ_λ=2.9226° 88.5 KM	σ_u=.27694° 8.80 KM σ_λ=5.8263° 177 KM	σ_u=.43117° 13.1 KM σ_λ=.68916° 20.8 KM	σ_u=.52663° 16.0 KM σ_λ=.32756° 9.99 KM	σ_u=.51396° 15.6 KM σ_λ=.30945° 9.38 KM
NAVIGATION	σ_u=.00321 σ_λ=.00155	σ_u=.00377 σ_λ=.00086	σ_u=.00303 σ_λ=.00324	σ_u=.00223 σ_λ=.02190	σ_u=.00341 σ_λ=.00262	σ_u=.00246 σ_λ=.03541	σ_u=.00322 σ_λ=.00171	σ_u=.00378 σ_λ=.00036	σ_u=.00378 σ_λ=.00037
ATTITUDE	σ_u=.40172 σ_λ=.67390	σ_u=.50533 σ_λ=.29762	σ_u=.36468 σ_λ=.67447	σ_u=.46692 σ_λ=2.5317	σ_u=.54063 σ_λ=2.9223	σ_u=.27687 σ_λ=5.8258	σ_u=.43116 σ_λ=.68916	σ_u=.52655 σ_λ=.32756	σ_u=.51338 σ_λ=.30944
CAMERA ON-TIME	σ_u=.00098 σ_λ=.00007	σ_u=.00111 σ_λ=.00009	σ_u=.00944 σ_λ=.00705	σ_u=.00065 σ_λ=.00693	σ_u=.00105 σ_λ=.00749	σ_u=.00085 σ_λ=.00905	σ_u=.00094 σ_λ=.00095	σ_u=.00108 σ_λ=.00025	σ_u=.00109 σ_λ=.00009
MOON RADIUS	σ_u=.00010 σ_λ=.00590	σ_u=.00929 σ_λ=.00462	σ_u=.00174 σ_λ=.00944	σ_u=.00815 σ_λ=.03755	σ_u=.00849 σ_λ=.02744	σ_u=.00553 σ_λ=.06727	σ_u=.00064 σ_λ=.00031	σ_u=.00819 σ_λ=.00143	σ_u=.00837 σ_λ=.00289

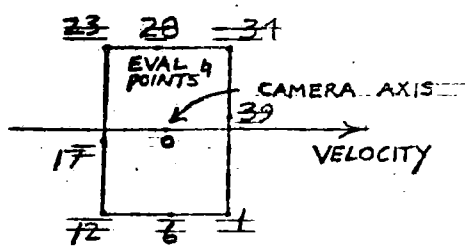
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.46834° 14.2 KM σ_λ=.72300° 22.0 KM	σ_u=ND° KM σ_λ=° KM	σ_u=° KM σ_λ=° KM ND	σ_u=° KM σ_λ=° KM ND	σ_u=° KM σ_λ=° KM ND	σ_u=° KM σ_λ=° KM ND	σ_u=.57908° 17.5 KM σ_λ=.94130° 28.5 KM	σ_u=° KM σ_λ=° KM ND	σ_u=° KM σ_λ=° KM ND
NAVIGATION	σ_u=.00322 σ_λ=.00155	σ_u= σ_λ= ND	σ_u= σ_λ= ND	σ_u= σ_λ= ND	σ_u= σ_λ= ND	σ_u= σ_λ= ND	σ_u=.00117 σ_λ=.00424	σ_u= σ_λ= ND	σ_u= σ_λ= ND
ATTITUDE	σ_u=.46833 σ_λ=.72297	σ_u= σ_λ= ND	σ_u= σ_λ= ND	σ_u= σ_λ= ND	σ_u= σ_λ= ND	σ_u= σ_λ= ND	σ_u=.57877 σ_λ=.94120	σ_u= σ_λ= ND	σ_u= σ_λ= ND
CAMERA ON-TIME	σ_u=.00098 σ_λ=.00007	σ_u= σ_λ= ND	σ_u= σ_λ= ND	σ_u= σ_λ= ND	σ_u= σ_λ= ND	σ_u= σ_λ= ND	σ_u=.00003 σ_λ=.00149	σ_u= σ_λ= ND	σ_u= σ_λ= ND
MOON RADIUS	σ_u=.00010 σ_λ=.00590	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.01909 σ_λ=.01280	σ_u= σ_λ=	σ_u= σ_λ=

* μ = LATITUDE λ = LONGITUDE

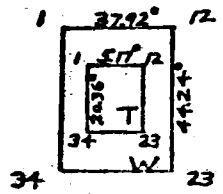
ERROR ANALYSIS RESULTS MISSION IV FRAME 10





S/C ALTITUDE = 2987 KM
TRUE ANOMALY = 317. °
INCLINATION ≈ 05. °
NOTE: 2ND OF SERIES

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

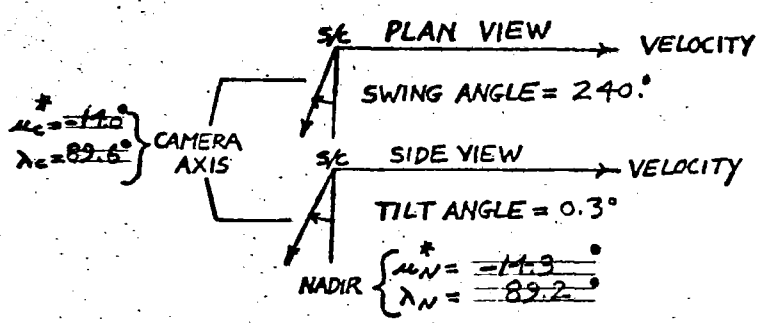
ERROR SOURCE	CAMERA AXIS (0)		EVAL POINT 1		EVAL POINT 6		EVAL POINT 12		EVAL POINT 17		EVAL POINT 23		EVAL POINT 28		EVAL POINT 34		EVAL POINT 39	
TOTAL	σ_u=.522° 15.8 KM	σ_λ=.504° 15.3 KM	σ_u=.657° 19.9 KM	σ_λ=.344° 10.4 KM	σ_u=.498° 15.1 KM	σ_λ=.485° 14.7 KM	σ_u=.423° 12.8 KM	σ_λ=1.27° 38.5 KM	σ_u=.490° 14.8 KM	σ_λ=1.26° 38.2 KM	σ_u=.581° 17.6 KM	σ_λ=1.23° 37.3 KM	σ_u=.556° 16.8 KM	σ_λ=.524° 15.8 KM	σ_u=.678° 20.5 KM	σ_λ=.346° 10.5 KM	σ_u=.664° 20.1 KM	σ_λ=.342° 10.4 KM
NAVIGATION	σ_u=.0031	σ_λ=.0009	σ_u=.0034	σ_λ=.0006	σ_u=.0031	σ_λ=.0010	σ_u=.0029	σ_λ=.0039	σ_u=.0032	σ_λ=.0025	σ_u=.0034	σ_λ=.0029	σ_u=.0031	σ_λ=.0008	σ_u=.0033	σ_λ=.0006	σ_u=.0034	σ_λ=.0006
ATTITUDE	σ_u=.522	σ_λ=.504	σ_u=.657	σ_λ=.344	σ_u=.498	σ_λ=.485	σ_u=.423	σ_λ=1.27	σ_u=.489	σ_λ=1.26	σ_u=.581	σ_λ=1.23	σ_u=.556	σ_λ=.524	σ_u=.678	σ_λ=.346	σ_u=.664	σ_λ=.342
CAMERA ON-TIME	σ_u=.0011	σ_λ= 0	σ_u=.0012	σ_λ=.0001	σ_u=.0011	σ_λ=.0001	σ_u=.0011	σ_λ=.0011	σ_u=.0012	σ_λ=.0009	σ_u=.0012	σ_λ=.0007	σ_u=.0011	σ_λ= 0	σ_u=.0011	σ_λ=.0002	σ_u=.0012	σ_λ=.0001
MOON RADIUS	σ_u=.0001	σ_λ=.0040	σ_u=.0074	σ_λ=.0026	σ_u=.0016	σ_λ=.0055	σ_u=.0031	σ_λ=.0190	σ_u=.0050	σ_λ=.0163	σ_u=.0069	σ_λ=.0123	σ_u=.0012	σ_λ=.0023	σ_u=.0058	σ_λ=.0005	σ_u=.0064	σ_λ=.0009

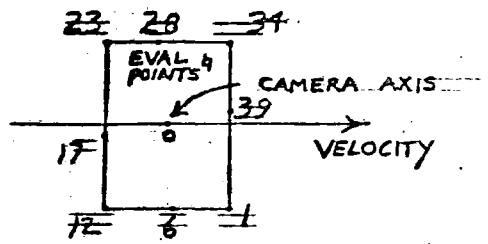
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS		EVAL POINT 1		EVAL POINT 6		EVAL POINT 12		EVAL POINT 17		EVAL POINT 23		EVAL POINT 28		EVAL POINT 34		EVAL POINT 39	
TOTAL	σ_u=.614° 18.6 KM	σ_λ=.552° 16.7 KM	σ_u= ND ° KM	σ_λ= ND ° KM	σ_u= ND ° KM	σ_λ= ND ° KM	σ_u= ND ° KM	σ_λ= ND ° KM	σ_u= ND ° KM	σ_λ= ND ° KM	σ_u= ND ° KM	σ_λ= ND ° KM	σ_u=.979° 29.6 KM	σ_λ=.909° 27.5 KM	σ_u= ND ° KM	σ_λ= ND ° KM	σ_u=3.27° 99.0 KM	σ_λ=.399° 12.1 KM
NAVIGATION	σ_u=.0031	σ_λ=.0009	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=.0027	σ_λ=.0036	σ_u=	σ_λ=	σ_u=.0094	σ_λ=.0009
ATTITUDE	σ_u=.614	σ_λ=.552	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=.979	σ_λ=.909	σ_u=	σ_λ=	σ_u=3.27	σ_λ=.399
CAMERA ON-TIME	σ_u=.0011	σ_λ= 0	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=.0009	σ_λ=.0015	σ_u=	σ_λ=	σ_u=.0030	σ_λ=.0001
MOON RADIUS	σ_u=.0001	σ_λ=.0040	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u=	σ_λ=	σ_u= 0	σ_λ=.0206	σ_u=	σ_λ=	σ_u=.0389	σ_λ=.0052

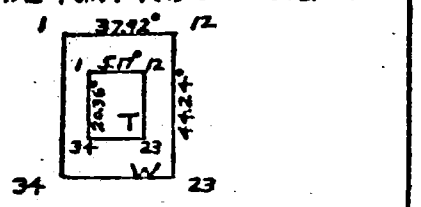
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION IV FRAME 14





S/C ALTITUDE = 2746. KM
TRUE ANOMALY = 345. °
INCLINATION = 85. °
NOTE: 3RD OF SERIES



TELEPHOTO LENS, T

ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.582° 17.6 KM; σ_λ=.342° 10.4 KM	σ_u=.673° 20.4 KM; σ_λ=.358° 10.8 KM	σ_u=.554° 16.8 KM; σ_λ=.342° 10.4 KM	σ_u=.656° 19.9 KM; σ_λ=.480° 14.5 KM	σ_u=.661° 20.0 KM; σ_λ=.455° 13.8 KM	σ_u=.705° 21.4 KM; σ_λ=.436° 13.2 KM	σ_u=.614° 18.6 KM; σ_λ=.348° 10.5 KM	σ_u=.731° 22.2 KM; σ_λ=.348° 10.5 KM	σ_u=.702° 21.3 KM; σ_λ=.349° 10.6 KM
NAVIGATION	σ_u=.00317; σ_λ=.00059	σ_u=.00349; σ_λ=.00055	σ_u=.00317; σ_λ=.00057	σ_u=.00351; σ_λ=.00072	σ_u=.00353; σ_λ=.00067	σ_u=.00355; σ_λ=.00071	σ_u=.00318; σ_λ=.00063	σ_u=.00346; σ_λ=.00063	σ_u=.00347; σ_λ=.00059
ATTITUDE	σ_u=.582; σ_λ=.342	σ_u=.673; σ_λ=.358	σ_u=.554; σ_λ=.342	σ_u=.625; σ_λ=.480	σ_u=.660; σ_λ=.455	σ_u=.705; σ_λ=.436	σ_u=.614; σ_λ=.348	σ_u=.731; σ_λ=.348	σ_u=.702; σ_λ=.349
CAMERA ON-TIME	σ_u=.00114; σ_λ=.00010	σ_u=.00126; σ_λ=.00011	σ_u=.00115; σ_λ=.00008	σ_u=.00127; σ_λ=0	σ_u=.00127; σ_λ=.00007	σ_u=.00128; σ_λ=.00017	σ_u=.00114; σ_λ=.00013	σ_u=.00125; σ_λ=.00008	σ_u=.00125; σ_λ=.00009
MOON RADIUS	σ_u=.00010; σ_λ=.00014	σ_u=.00703; σ_λ=.00127	σ_u=.00080; σ_λ=.00165	σ_u=.00637; σ_λ=.00312	σ_u=.00654; σ_λ=.00111	σ_u=.00672; σ_λ=.00131	σ_u=.00055; σ_λ=.00141	σ_u=.00674; σ_λ=.00203	σ_u=.00681; σ_λ=.00053

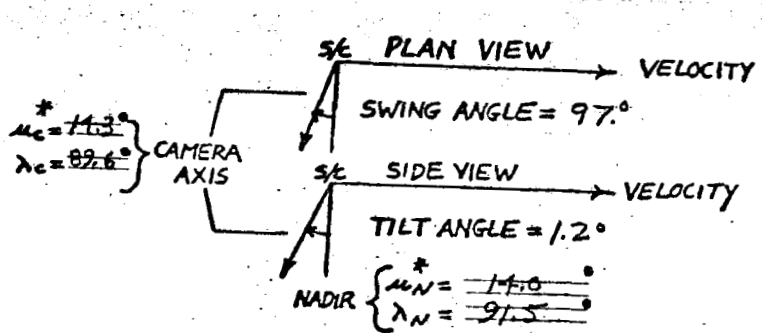
WIDE-ANGLE LENS, W

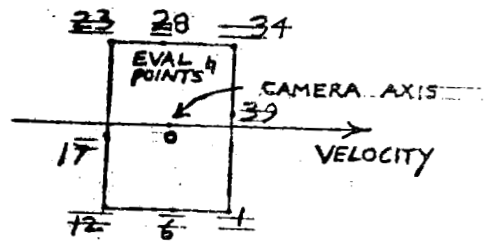
ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.690° 20.9 KM; σ_λ=.355° 10.8 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=.539° 16.3 KM; σ_λ=.800° 24.2 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=3.065° 92.9 KM; σ_λ=4.114° 125. KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=1.101° 33.4 KM; σ_λ=.757° 22.9 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=5.913° 179. KM; σ_λ=1.098° 33.3 KM
NAVIGATION	σ_u=.00317; σ_λ=.00059	σ_u=; σ_λ=	σ_u=.00324; σ_λ=.00055	σ_u=; σ_λ=	σ_u=.00973; σ_λ=.00765	σ_u=; σ_λ=	σ_u=.00312; σ_λ=.00179	σ_u=; σ_λ=	σ_u=.0145; σ_λ=.00316
ATTITUDE	σ_u=.690; σ_λ=.355	σ_u=; σ_λ=	σ_u=.539; σ_λ=.800	σ_u=; σ_λ=	σ_u=3.064; σ_λ=4.114	σ_u=; σ_λ=	σ_u=1.101; σ_λ=.756	σ_u=; σ_λ=	σ_u=5.913; σ_λ=1.098
CAMERA ON-TIME	σ_u=.00114; σ_λ=.00010	σ_u=; σ_λ=	σ_u=.00121; σ_λ=.00017	σ_u=; σ_λ=	σ_u=.00399; σ_λ=.00357	σ_u=; σ_λ=	σ_u=.00110; σ_λ=.00059	σ_u=; σ_λ=	σ_u=.00492; σ_λ=.00087
MOON RADIUS	σ_u=.00010; σ_λ=.00014	σ_u=↓; σ_λ=↓	σ_u=.00634; σ_λ=.0204	σ_u=↓; σ_λ=↓	σ_u=.0454; σ_λ=.0468	σ_u=↓; σ_λ=↓	σ_u=.00027; σ_λ=.0204	σ_u=↓; σ_λ=↓	σ_u=.0586; σ_λ=.0143

* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS

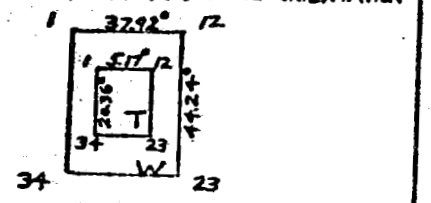
MISSION IV FRAME 18





S/C ALTITUDE = 2738. KM
TRUE ANOMALY = 13.2 °
INCLINATION ≈ 85. °
NOTE: 4th OF SERIES

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

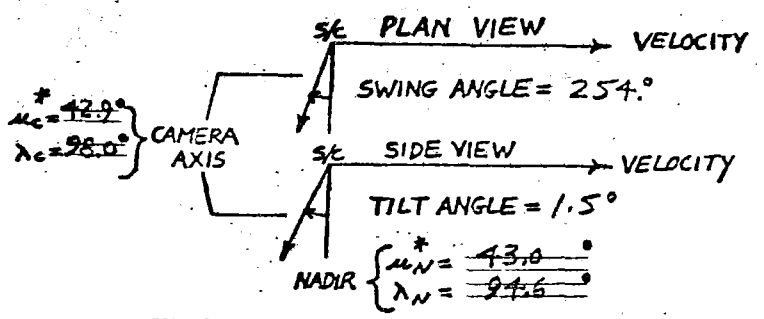
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.699° 21.2 KM; σ_λ=.354° 11.6 KM	σ_u=.758° 23.0 KM; σ_λ=.549° 16.6 KM	σ_u=.660° 20.0 KM; σ_λ=.392° 11.9 KM	σ_u=.791° 24.0 KM; σ_λ=.383° 11.6 KM	σ_u=.821° 24.9 KM; σ_λ=.380° 11.5 KM	σ_u=.864° 26.2 KM; σ_λ=.386° 11.7 KM	σ_u=.740° 22.4 KM; σ_λ=.385° 11.7 KM	σ_u=.861° 26.1 KM; σ_λ=.502° 15.2 KM	σ_u=.812° 24.6 KM; σ_λ=.518° 15.7 KM
NAVIGATION	σ_u=.00340; σ_λ=.00057	σ_u=.00373; σ_λ=.00072	σ_u=.00339; σ_λ=.00055	σ_u=.00376; σ_λ=.00053	σ_u=.00373; σ_λ=.00060	σ_u=.00374; σ_λ=.00070	σ_u=.00340; σ_λ=.00060	σ_u=.00378; σ_λ=.00064	σ_u=.00376; σ_λ=.00063
ATTITUDE	σ_u=.699; σ_λ=.384	σ_u=.758; σ_λ=.549	σ_u=.660; σ_λ=.392	σ_u=.791; σ_λ=.383	σ_u=.821; σ_λ=.380	σ_u=.864; σ_λ=.386	σ_u=.740; σ_λ=.385	σ_u=.861; σ_λ=.502	σ_u=.812; σ_λ=.518
CAMERA ON-TIME	σ_u=.00115; σ_λ=.00009	σ_u=.00127; σ_λ=.00021	σ_u=.00115; σ_λ=.00012	σ_u=.00125; σ_λ=.00010	σ_u=.00125; σ_λ=.00011	σ_u=.00125; σ_λ=.00013	σ_u=.00115; σ_λ=.00007	σ_u=.00129; σ_λ=.00003	σ_u=.00129; σ_λ=.00011
MOON RADIUS	σ_u=.00015; σ_λ=.00068	σ_u=.00661; σ_λ=.00226	σ_u=.00052; σ_λ=.00036	σ_u=.00666; σ_λ=.00117	σ_u=.00649; σ_λ=.00130	σ_u=.00641; σ_λ=.00312	σ_u=.00227; σ_λ=.00232	σ_u=.00711; σ_λ=.00224	σ_u=.00689; σ_λ=.00015

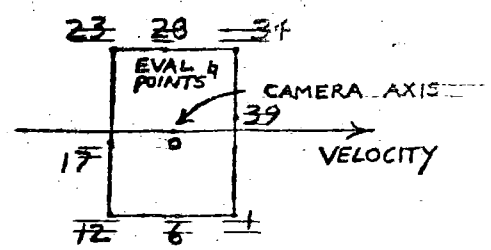
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.829° 25.1 KM; σ_λ=.401° 12.2 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=.544° 16.5 KM; σ_λ=.789° 23.9 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=3.80° 115. KM; σ_λ=.612° 18.6 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=1.38° 41.9 KM; σ_λ=.987° 29.9 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u= ND° KM; σ_λ= ND° KM
NAVIGATION	σ_u=.00340; σ_λ=.00057	σ_u=; σ_λ=	σ_u=.00332; σ_λ=.00067	σ_u=; σ_λ=	σ_u=.00641; σ_λ=.00129	σ_u=; σ_λ=	σ_u=.00343; σ_λ=.00175	σ_u=; σ_λ=	σ_u=; σ_λ=
ATTITUDE	σ_u=.829; σ_λ=.401	σ_u=; σ_λ=	σ_u=.544; σ_λ=.789	σ_u=; σ_λ=	σ_u=3.80; σ_λ=.612	σ_u=; σ_λ=	σ_u=1.38; σ_λ=.987	σ_u=; σ_λ=	σ_u=; σ_λ=
CAMERA ON-TIME	σ_u=.00115; σ_λ=.00009	σ_u=; σ_λ=	σ_u=.00111; σ_λ=.00035	σ_u=; σ_λ=	σ_u=.00389; σ_λ=.00055	σ_u=; σ_λ=	σ_u=.00115; σ_λ=.00007	σ_u=; σ_λ=	σ_u=; σ_λ=
MOON RADIUS	σ_u=.00015; σ_λ=.00068	σ_u=; σ_λ=	σ_u=.00236; σ_λ=.0172	σ_u=; σ_λ=	σ_u=.0457; σ_λ=.00639	σ_u=; σ_λ=	σ_u=.00370; σ_λ=.0253	σ_u=; σ_λ=	σ_u=; σ_λ=

* u = LATITUDE λ = LONGITUDE

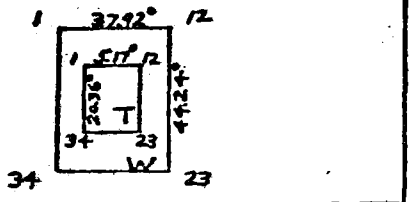
ERROR ANALYSIS RESULTS MISSION IV FRAME 22





S/C ALTITUDE = 2979. KM
TRUE ANOMALY = 42.4 °
INCLINATION ≈ 85 °
NOTE: 5TH OF SERIES

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

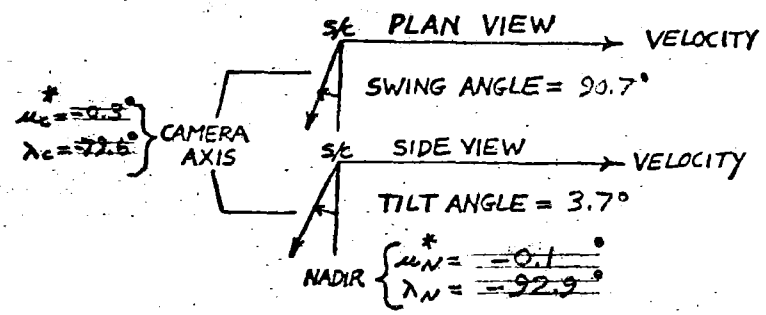
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .807° 24.4 KM; σ_λ = .685° 20.8 KM	σ_u = .698° 21.1 KM; σ_λ = 1.66° 50.3 KM	σ_u = .745° 22.6 KM; σ_λ = .735° 22.3 KM	σ_u = .992° 30.0 KM; σ_λ = .476° 14.4 KM	σ_u = 1.01° 30.6 KM; σ_λ = .481° 14.6 KM	σ_u = 1.05° 31.8 KM; σ_λ = .494° 15.0 KM	σ_u = .869° 26.3 KM; σ_λ = .646° 19.6 KM	σ_u = .937° 28.4 KM; σ_λ = 1.54° 46.7 KM	σ_u = .824° 25.0 KM; σ_λ = 1.62° 49.1 KM
NAVIGATION	σ_u = .00376; σ_λ = .00111	σ_u = .00362; σ_λ = .00469	σ_u = .00368; σ_λ = .00154	σ_u = .00424; σ_λ = .00072	σ_u = .00422; σ_λ = .00066	σ_u = .00421; σ_λ = .00057	σ_u = .00382; σ_λ = .00070	σ_u = .00421; σ_λ = .00291	σ_u = .00396; σ_λ = .00392
ATTITUDE	σ_u = .807; σ_λ = .685	σ_u = .698; σ_λ = 1.66	σ_u = .745; σ_λ = .735	σ_u = .992; σ_λ = .476	σ_u = 1.01; σ_λ = .481	σ_u = 1.05; σ_λ = .494	σ_u = .869; σ_λ = .646	σ_u = .937; σ_λ = 1.54	σ_u = .824; σ_λ = 1.62
CAMERA ON-TIME	σ_u = .00108; σ_λ = .00024	σ_u = .00103; σ_λ = .00116	σ_u = .00106; σ_λ = .00037	σ_u = .00119; σ_λ = .00015	σ_u = .00118; σ_λ = .00012	σ_u = .00117; σ_λ = .00007	σ_u = .00109; σ_λ = .00012	σ_u = .00124; σ_λ = .00064	σ_u = .00118; σ_λ = .00092
MOON RADIUS	σ_u = .00005; σ_λ = .00125	σ_u = .00456; σ_λ = .0127	σ_u = .00026; σ_λ = .00362	σ_u = .00748; σ_λ = .00354	σ_u = .00688; σ_λ = .00685	σ_u = .00646; σ_λ = .00258	σ_u = .00011; σ_λ = .00107	σ_u = .00725; σ_λ = .00479	σ_u = .00617; σ_λ = .00830

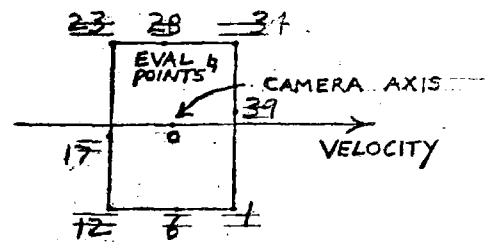
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .954° 28.9 KM; σ_λ = .746° 22.6 KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = 1.50° 45.5 KM; σ_λ = 1.88° 57.0 KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = 1.55° 47.0 KM; σ_λ = 1.25° 37.9 KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM
NAVIGATION	σ_u = .00376; σ_λ = .00111	σ_u =; σ_λ =	σ_u = .00289; σ_λ = .00205	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u = .00349; σ_λ = .00267	σ_u =; σ_λ =	σ_u =; σ_λ =
ATTITUDE	σ_u = .954; σ_λ = .746	σ_u =; σ_λ =	σ_u = 1.50; σ_λ = 1.88	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u = 1.55; σ_λ = 1.25	σ_u =; σ_λ =	σ_u =; σ_λ =
CAMERA ON-TIME	σ_u = .00109; σ_λ = .00024	σ_u =; σ_λ =	σ_u = .00085; σ_λ = .00072	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u = .00091; σ_λ = .00086	σ_u =; σ_λ =	σ_u =; σ_λ =
MOON RADIUS	σ_u = .00005; σ_λ = .00125	σ_u =; σ_λ =	σ_u = .0255; σ_λ = .0315	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u = .00704; σ_λ = .0226	σ_u =; σ_λ =	σ_u =; σ_λ =

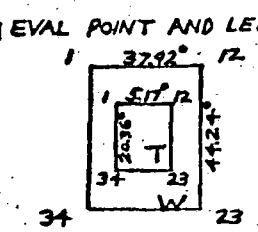
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION IV FRAME 25





S/C ALTITUDE = 6168. KM
TRUE ANOMALY = 179. °
INCLINATION ≈ 85 °
NOTE: R(167°) P(45°) Y(0°)
CELESTIAL ALIGNMENT



TELEPHOTO LENS, T

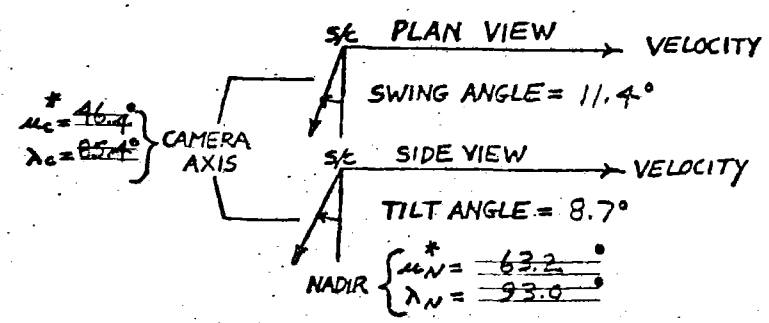
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u=.16570° 23.2 KM $\nabla\lambda$=.44386° 13.4 KM	∇u=1.3580° 41.3 KM $\nabla\lambda$=.67009° 20.3 KM	∇u=.72145° 21.9 KM $\nabla\lambda$=.42675° 13.0 KM	∇u= KM $\nabla\lambda$= KM N/D	∇u= KM $\nabla\lambda$= KM N/D	∇u= KM $\nabla\lambda$= KM N/D	∇u=.82377° 25.0 KM $\nabla\lambda$=.49579° 15.1 KM	∇u= KM $\nabla\lambda$= KM N/D	∇u= KM $\nabla\lambda$= KM N/D
NAVIGATION	∇u=.01083 $\nabla\lambda$=.00216	∇u=.02188 $\nabla\lambda$=.00929	∇u=.01080 $\nabla\lambda$=.00202	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u=.01092 $\nabla\lambda$=.00247	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D
ATTITUDE	∇u=.16563 $\nabla\lambda$=.44384	∇u=1.3577 $\nabla\lambda$=.67002	∇u=.72131 $\nabla\lambda$=.42675	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u=.82369 $\nabla\lambda$=.49573	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D
CAMERA ON-TIME	∇u=.00065 $\nabla\lambda$=.00005	∇u=.00108 $\nabla\lambda$=.00019	∇u=.00066 $\nabla\lambda$=.00006	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u=.00065 $\nabla\lambda$=.00004	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D
MOON RADIUS	∇u=.00007 $\nabla\lambda$=.00401	∇u=.01756 $\nabla\lambda$=.00340	∇u=.00101 $\nabla\lambda$=.00118	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u=.00092 $\nabla\lambda$=.00753	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=

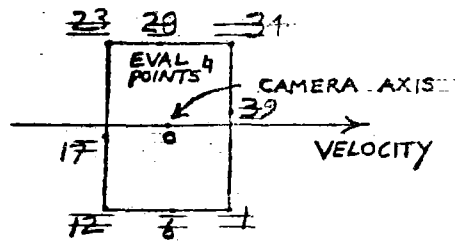
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u=.83297° 25.3 KM $\nabla\lambda$=.45617° 13.8 KM	∇u= KM $\nabla\lambda$= KM N/D	∇u= KM $\nabla\lambda$= KM N/D	∇u= KM $\nabla\lambda$= KM N/D	∇u= KM $\nabla\lambda$= KM N/D	∇u= KM $\nabla\lambda$= KM N/D	∇u= KM $\nabla\lambda$= KM N/D	∇u= KM $\nabla\lambda$= KM N/D	∇u= KM $\nabla\lambda$= KM N/D
NAVIGATION	∇u=.01083 $\nabla\lambda$=.00216	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D
ATTITUDE	∇u=.83289 $\nabla\lambda$=.45615	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D
CAMERA ON-TIME	∇u=.00065 $\nabla\lambda$=.00005	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D	∇u= $\nabla\lambda$= N/D
MOON RADIUS	∇u=.00007 $\nabla\lambda$=.00401	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=

* u = LATITUDE λ = LONGITUDE

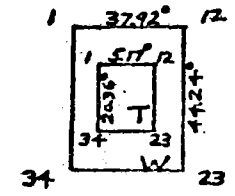
ERROR ANALYSIS RESULTS MISSION IV FRAME 30





S/C ALTITUDE = 3307 KM
TRUE ANOMALY = 62.9 °
INCLINATION ≈ 85 °
NOTE: 5th OF SERIES

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

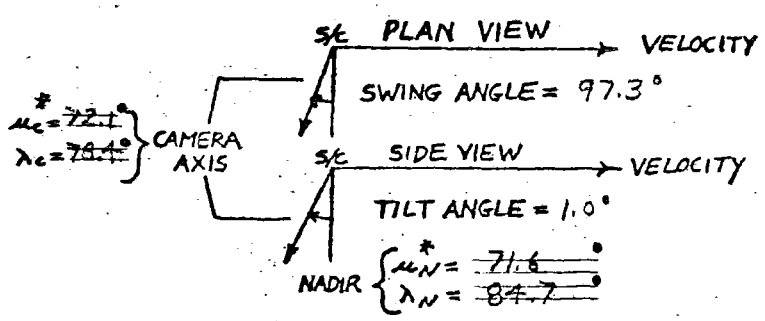
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .998° 30.2 KM; σ_λ = .691° 21.0 KM	σ_u = .762° 23.1 KM; σ_λ = 1.62° 49.1 KM	σ_u = .894° 27.0 KM; σ_λ = .754° 22.8 KM	σ_u = 2.70° 81.8 KM; σ_λ = .501° 15.2 KM	σ_u = 2.94° 86.0 KM; σ_λ = .511° 15.5 KM	σ_u = ND KM; σ_λ = ND KM	σ_u = 1.12° 34.0 KM; σ_λ = .651° 19.7 KM	σ_u = .973° 29.5 KM; σ_λ = 1.23° 37.3 KM	σ_u = .885° 26.8 KM; σ_λ = 1.41° 42.7 KM
NAVIGATION	σ_u = .0039; σ_λ = .0002	σ_u = .0034; σ_λ = .0017	σ_u = .0038; σ_λ = .0006	σ_u = .0097; σ_λ = .0005	σ_u = .0097; σ_λ = .0006	σ_u = ; σ_λ =	σ_u = .0040; σ_λ = .0003	σ_u = .0034; σ_λ = .0017	σ_u = .0035; σ_λ = .0003
ATTITUDE	σ_u = .998; σ_λ = .691	σ_u = .762; σ_λ = 1.62	σ_u = .894; σ_λ = .754	σ_u = 2.70; σ_λ = .501	σ_u = 2.94; σ_λ = .511	σ_u = ; σ_λ =	σ_u = 1.12; σ_λ = .651	σ_u = .973; σ_λ = 1.23	σ_u = .885; σ_λ = 1.41
CAMERA ON-TIME	σ_u = .0011; σ_λ = .0001	σ_u = .0010; σ_λ = .0007	σ_u = .0010; σ_λ = .0003	σ_u = .0024; σ_λ = .0002	σ_u = .0025; σ_λ = .0002	σ_u = ; σ_λ =	σ_u = .0011; σ_λ = 0	σ_u = .0010; σ_λ = .0004	σ_u = .0010; σ_λ = .0001
MOON RADIUS	σ_u = .0063; σ_λ = .0019	σ_u = .0010; σ_λ = .0019	σ_u = .0055; σ_λ = 0	σ_u = .0328; σ_λ = .0030	σ_u = .0333; σ_λ = .0030	σ_u = ; σ_λ =	σ_u = .0076; σ_λ = .0036	σ_u = .0006; σ_λ = .0076	σ_u = .0011; σ_λ = .0033

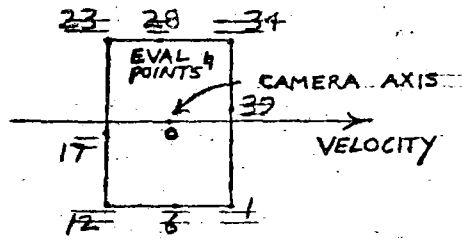
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = 1.18° 35.8 KM; σ_λ = .738° 22.4 KM	σ_u = ND KM; σ_λ = ND KM	σ_u = 1.42° 43.0 KM; σ_λ = 1.12° 34.0 KM	σ_u = ND KM; σ_λ = ND KM	σ_u = ND KM; σ_λ = ND KM	σ_u = ND KM; σ_λ = ND KM	σ_u = ND KM; σ_λ = ND KM	σ_u = ND KM; σ_λ = ND KM	σ_u = ND KM; σ_λ = ND KM
NAVIGATION	σ_u = .0039; σ_λ = .0002	σ_u = ; σ_λ =	σ_u = .0044; σ_λ = .0017	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =
ATTITUDE	σ_u = 1.18; σ_λ = .738	σ_u = ; σ_λ =	σ_u = 1.42; σ_λ = 1.12	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =
CAMERA ON-TIME	σ_u = .0011; σ_λ = .0001	σ_u = ; σ_λ =	σ_u = .0009; σ_λ = .0007	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =
MOON RADIUS	σ_u = .0063; σ_λ = .0019	σ_u = ; σ_λ =	σ_u = .0262; σ_λ = .0150	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =	σ_u = ; σ_λ =

* σ_u = LATITUDE σ_λ = LONGITUDE

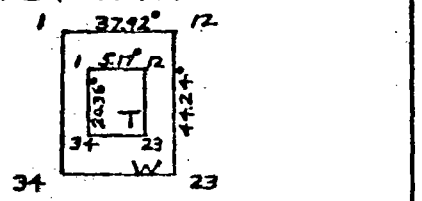
ERROR ANALYSIS RESULTS MISSION IV FRAME 42





S/C ALTITUDE = 3492. KM
TRUE ANOMALY = 71.9 °
INCLINATION ≈ 85. °
NOTE: 5TH OF SERIES

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .909° 27.5 KM; σ_λ = 1.62° 49.1 KM	σ_u = 1.03° 31.2 KM; σ_λ = 5.33° 161. KM	σ_u = .774° 23.4 KM; σ_λ = 2.13° 64.5 KM	σ_u = 1.08° 32.7 KM; σ_λ = .653° 19.8 KM	σ_u = 1.13° 34.3 KM; σ_λ = .668° 20.2 KM	σ_u = 1.20° 36.4 KM; σ_λ = .710° 21.5 KM	σ_u = .987° 29.9 KM; σ_λ = 1.34° 40.6 KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM
NAVIGATION	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = 0 σ_λ = 0	σ_u = σ_λ =	σ_u = σ_λ =
ATTITUDE	σ_u = .909 σ_λ = 1.62	σ_u = 1.03 σ_λ = 5.33	σ_u = .774 σ_λ = 2.13	σ_u = 1.08 σ_λ = .653	σ_u = 1.13 σ_λ = .668	σ_u = 1.20 σ_λ = .710	σ_u = .987 σ_λ = 1.34	σ_u = σ_λ =	σ_u = σ_λ =
CAMERA ON-TIME	σ_u = .00097 σ_λ = .00053	σ_u = .00073 σ_λ = .00693	σ_u = .00088 σ_λ = .00155	σ_u = .00106 σ_λ = .00038	σ_u = .00109 σ_λ = .00023	σ_u = .00110 σ_λ = .00004	σ_u = .00098 σ_λ = .00030	σ_u = σ_λ =	σ_u = σ_λ =
MOON RADIUS	σ_u = .00015 σ_λ = .00222	σ_u = .00540 σ_λ = .0475	σ_u = .00026 σ_λ = .00434	σ_u = .00821 σ_λ = .00024	σ_u = .00305 σ_λ = .00167	σ_u = .00850 σ_λ = .00342	σ_u = .00098 σ_λ = .00698	σ_u = ↓ σ_λ = ↓	σ_u = ↓ σ_λ = ↓

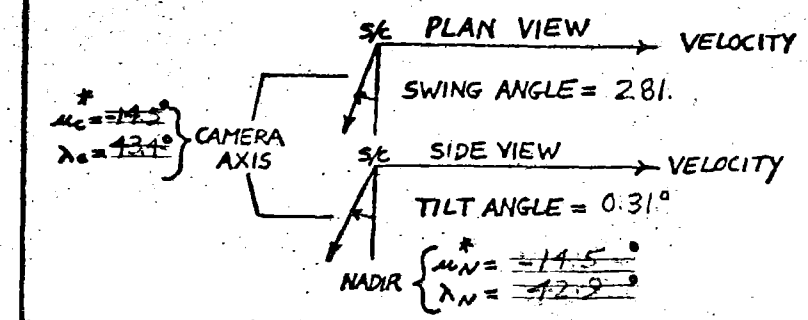
WIDE-ANGLE LENS, W

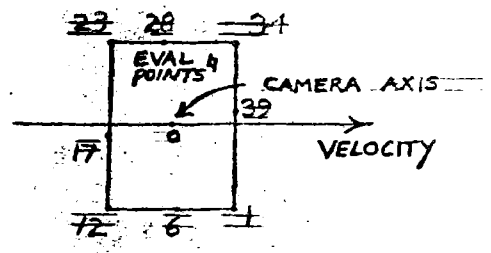
ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = 1.07° 32.4 KM; σ_λ = 1.76° 53.4 KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = 1.37° 56.6 KM; σ_λ = 1.39° 42.1 KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM
NAVIGATION	σ_u = 0 σ_λ = 0	σ_u = σ_λ =	σ_u = 0 σ_λ = 0	σ_u = σ_λ =	σ_u = σ_λ =	σ_u = σ_λ =	σ_u = σ_λ =	σ_u = σ_λ =	σ_u = σ_λ =
ATTITUDE	σ_u = 1.07 σ_λ = 1.76	σ_u = σ_λ =	σ_u = 1.87 σ_λ = 1.39	σ_u = σ_λ =	σ_u = σ_λ =	σ_u = σ_λ =	σ_u = σ_λ =	σ_u = σ_λ =	σ_u = σ_λ =
CAMERA ON-TIME	σ_u = .00097 σ_λ = .00053	σ_u = σ_λ =	σ_u = .00029 σ_λ = .00143	σ_u = σ_λ =	σ_u = σ_λ =	σ_u = σ_λ =	σ_u = σ_λ =	σ_u = σ_λ =	σ_u = σ_λ =
MOON RADIUS	σ_u = .00015 σ_λ = .00222	σ_u = ↓ σ_λ = ↓	σ_u = .0303 σ_λ = .0160	σ_u = ↓ σ_λ = ↓	σ_u = ↓ σ_λ = ↓	σ_u = ↓ σ_λ = ↓	σ_u = ↓ σ_λ = ↓	σ_u = ↓ σ_λ = ↓	σ_u = ↓ σ_λ = ↓

* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS

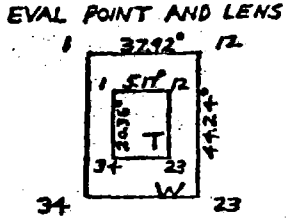
MISSION IV FRAME 65





S/C ALTITUDE = 2733 KM
TRUE ANOMALY = 345°
INCLINATION ≈ 65°
NOTE: APOLLO FRAME
2ND OF SERIES

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.478° 14.5 KM; σ_λ=.239° 7.25 KM	σ_u=.549° 16.4 KM; σ_λ=.253° 7.65 KM	σ_u=.454° 13.7 KM; σ_λ=.239° 7.24 KM	σ_u=.515° 15.3 KM; σ_λ=.363° 11.0 KM	σ_u=.545° 16.5 KM; σ_λ=.341° 10.3 KM	σ_u=.584° 17.7 KM; σ_λ=.320° 9.70 KM	σ_u=.507° 15.4 KM; σ_λ=.243° 7.35 KM	σ_u=.599° 18.1 KM; σ_λ=.244° 7.40 KM	σ_u=.574° 17.4 KM; σ_λ=.245° 7.42 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.478 σ_λ=.239	σ_u=.549 σ_λ=.253	σ_u=.454 σ_λ=.239	σ_u=.515 σ_λ=.363	σ_u=.545 σ_λ=.341	σ_u=.584 σ_λ=.320	σ_u=.507 σ_λ=.243	σ_u=.599 σ_λ=.244	σ_u=.574 σ_λ=.245
CAMERA ON-TIME	σ_u=.00115 σ_λ=.00009	σ_u=.00126 σ_λ=.00010	σ_u=.00115 σ_λ=.00007	σ_u=.00127 σ_λ=.00002	σ_u=.00123 σ_λ=.00006	σ_u=.00129 σ_λ=.00016	σ_u=.00115 σ_λ=.00012	σ_u=.00125 σ_λ=.00007	σ_u=.00125 σ_λ=.00008
MOON RADIUS	σ_u=.00002 σ_λ=.00018	σ_u=.00685 σ_λ=.00127	σ_u=.00069 σ_λ=.00163	σ_u=.00649 σ_λ=.00225	σ_u=.00667 σ_λ=.00122	σ_u=.00686 σ_λ=.00122	σ_u=.00068 σ_λ=.00137	σ_u=.00655 σ_λ=.00200	σ_u=.00662 σ_λ=.00057

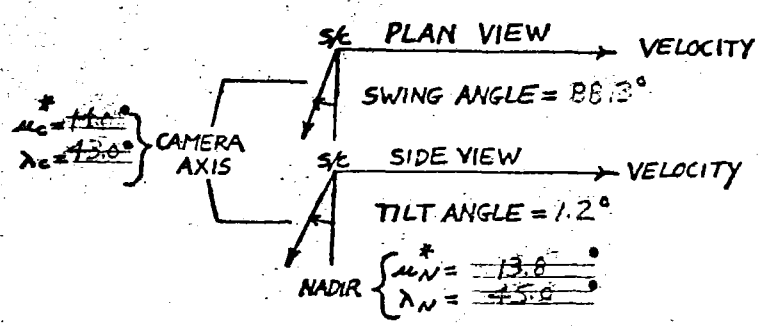
WIDE-ANGLE LENS, W

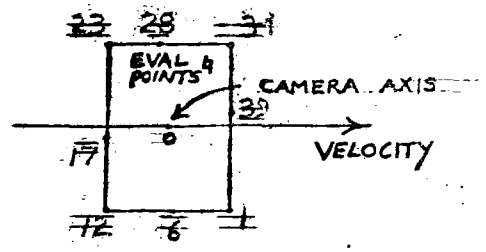
ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.568° 17.2 KM; σ_λ=.249° 7.54 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=.420° 12.7 KM; σ_λ=.555° 16.9 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=2.74° 83.0 KM; σ_λ=4.06° 124. KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=.920° 27.9 KM; σ_λ=.529° 16.0 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=3.48° 105. KM; σ_λ=.508° 15.4 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u= σ_λ=	σ_u=0 σ_λ=0	σ_u= σ_λ=	σ_u=0 σ_λ=0	σ_u= σ_λ=	σ_u=0 σ_λ=0	σ_u= σ_λ=	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.568 σ_λ=.249	σ_u= σ_λ=	σ_u=.420 σ_λ=.555	σ_u= σ_λ=	σ_u=2.74 σ_λ=4.06	σ_u= σ_λ=	σ_u=.920 σ_λ=.528	σ_u= σ_λ=	σ_u=3.48 σ_λ=.508
CAMERA ON-TIME	σ_u=.00115 σ_λ=.00009	σ_u= σ_λ=	σ_u=.00121 σ_λ=.00015	σ_u= σ_λ=	σ_u=.00455 σ_λ=.00458	σ_u= σ_λ=	σ_u=.00111 σ_λ=.00059	σ_u= σ_λ=	σ_u=.00401 σ_λ=.00060
MOON RADIUS	σ_u=.00002 σ_λ=.00018	σ_u= σ_λ=	σ_u=.00626 σ_λ=.0203	σ_u= σ_λ=	σ_u=.0494 σ_λ=.0586	σ_u= σ_λ=	σ_u=.00004 σ_λ=.0202	σ_u= σ_λ=	σ_u=.0478 σ_λ=.0110

* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS

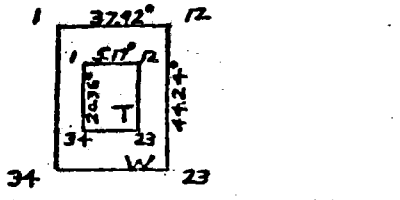
MISSION IV FRAME 66





S/C ALTITUDE = 272.9 KM
TRUE ANOMALY = 13.7°
INCLINATION ≈ 65.°
NOTE: APOLLO EQUIV 3RD OF SERIES

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

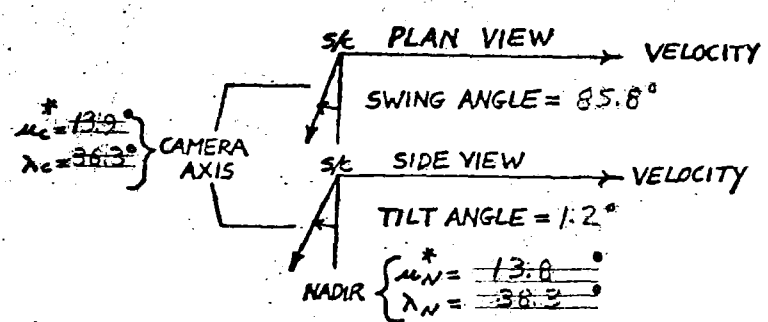
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .592° 17.9 KM $\nabla\lambda$ = .793° 8.87 KM	∇u = .635° 19.2 KM $\nabla\lambda$ = .434° 13.1 KM	∇u = .557° 16.9 KM $\nabla\lambda$ = .300° 9.09 KM	∇u = .671° 20.4 KM $\nabla\lambda$ = .297° 9.05 KM	∇u = .699° 21.2 KM $\nabla\lambda$ = .293° 8.87 KM	∇u = .738° 22.3 KM $\nabla\lambda$ = .297° 9.05 KM	∇u = .629° 19.0 KM $\nabla\lambda$ = .294° 8.90 KM	∇u = .726° 22.1 KM $\nabla\lambda$ = .391° 11.8 KM	∇u = .683° 20.7 KM $\nabla\lambda$ = .407° 12.3 KM
NAVIGATION	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0	∇u = 0 $\nabla\lambda$ = 0
ATTITUDE	∇u = .592 $\nabla\lambda$ = .293	∇u = .635 $\nabla\lambda$ = .434	∇u = .557 $\nabla\lambda$ = .300	∇u = .671 $\nabla\lambda$ = .297	∇u = .699 $\nabla\lambda$ = .293	∇u = .738 $\nabla\lambda$ = .297	∇u = .629 $\nabla\lambda$ = .294	∇u = .726 $\nabla\lambda$ = .391	∇u = .683 $\nabla\lambda$ = .407
CAMERA ON-TIME	∇u = .00115 $\nabla\lambda$ = .00008	∇u = .00127 $\nabla\lambda$ = .00019	∇u = .00115 $\nabla\lambda$ = .00011	∇u = .00126 $\nabla\lambda$ = .00008	∇u = .00126 $\nabla\lambda$ = .00011	∇u = .00126 $\nabla\lambda$ = .00013	∇u = .00115 $\nabla\lambda$ = .00006	∇u = .00129 $\nabla\lambda$ = .00001	∇u = .00128 $\nabla\lambda$ = .00009
MOON RADIUS	∇u = .00005 $\nabla\lambda$ = .00075	∇u = .00647 $\nabla\lambda$ = .00208	∇u = .00042 $\nabla\lambda$ = .00088	∇u = .00679 $\nabla\lambda$ = .00213	∇u = .00662 $\nabla\lambda$ = .00135	∇u = .00658 $\nabla\lambda$ = .00318	∇u = .00338 $\nabla\lambda$ = .00238	∇u = .00694 $\nabla\lambda$ = .00234	∇u = .00674 $\nabla\lambda$ = .00029

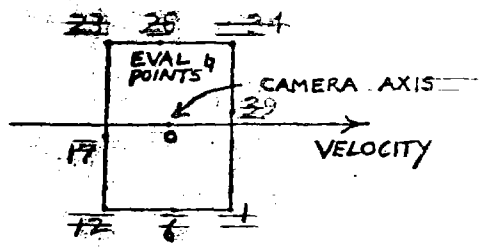
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .702° 21.3 KM $\nabla\lambda$ = .306° 9.26 KM	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = .440° 13.3 KM $\nabla\lambda$ = .597° 18.1 KM	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = 3.46° 105. KM $\nabla\lambda$ = .485° 14.7 KM	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = 1.20° 36.4 KM $\nabla\lambda$ = .762° 23.1 KM	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = 4.94° 150. KM $\nabla\lambda$ = 1.42° 43.0 KM
NAVIGATION	∇u = 0 $\nabla\lambda$ = 0	∇u = $\nabla\lambda$ =	∇u = 0 $\nabla\lambda$ = 0	∇u = $\nabla\lambda$ =	∇u = 0 $\nabla\lambda$ = 0	∇u = $\nabla\lambda$ =	∇u = 0 $\nabla\lambda$ = 0	∇u = $\nabla\lambda$ =	∇u = 0 $\nabla\lambda$ = 0
ATTITUDE	∇u = .702 $\nabla\lambda$ = .306	∇u = $\nabla\lambda$ =	∇u = .440 $\nabla\lambda$ = .596	∇u = $\nabla\lambda$ =	∇u = 3.46 $\nabla\lambda$ = .485	∇u = $\nabla\lambda$ =	∇u = 1.20 $\nabla\lambda$ = .761	∇u = $\nabla\lambda$ =	∇u = 4.94 $\nabla\lambda$ = 1.42
CAMERA ON-TIME	∇u = .00115 $\nabla\lambda$ = .00008	∇u = $\nabla\lambda$ =	∇u = .00111 $\nabla\lambda$ = .00033	∇u = $\nabla\lambda$ =	∇u = .00420 $\nabla\lambda$ = .00060	∇u = $\nabla\lambda$ =	∇u = .00115 $\nabla\lambda$ = .00007	∇u = $\nabla\lambda$ =	∇u = .00476 $\nabla\lambda$ = .00026
MOON RADIUS	∇u = .00005 $\nabla\lambda$ = .00075	∇u = $\nabla\lambda$ =	∇u = .00231 $\nabla\lambda$ = .0168	∇u = $\nabla\lambda$ =	∇u = .0494 $\nabla\lambda$ = .00712	∇u = $\nabla\lambda$ =	∇u = .00396 $\nabla\lambda$ = .0256	∇u = $\nabla\lambda$ =	∇u = .0536 $\nabla\lambda$ = .00599

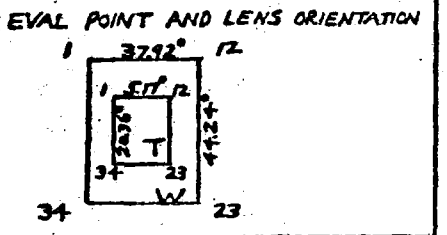
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION IV FRAME 73





S/C ALTITUDE = 2724 KM
TRUE ANOMALY = 13.5°
INCLINATION ≈ 85°
NOTE: APOLLO FRAME
4TH OF SERIES



TELEPHOTO LENS, T

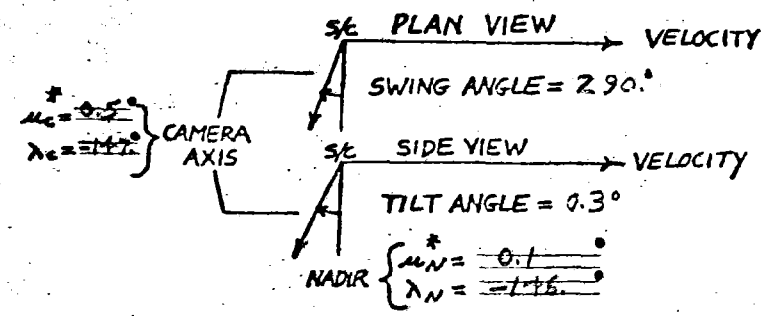
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.702° 21.3 KM; σ_λ=.391° 11.9 KM	σ_u=.764° 23.1 KM; σ_λ=.535° 16.2 KM	σ_u=.668° 20.2 KM; σ_λ=.397° 12.0 KM	σ_u=.801° 24.3 KM; σ_λ=.390° 11.8 KM	σ_u=.827° 25.1 KM; σ_λ=.389° 11.8 KM	σ_u=.816° 26.1 KM; σ_λ=.395° 12.0 KM	σ_u=.739° 22.4 KM; σ_λ=.393° 11.9 KM	σ_u=.855° 25.9 KM; σ_λ=.495° 15.0 KM	σ_u=.812° 24.6 KM; σ_λ=.507° 15.4 KM
NAVIGATION	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0	σ_u=0; σ_λ=0
ATTITUDE	σ_u=.702; σ_λ=.390	σ_u=.764; σ_λ=.535	σ_u=.668; σ_λ=.397	σ_u=.801; σ_λ=.390	σ_u=.82; σ_λ=.389	σ_u=.966; σ_λ=.395	σ_u=.739; σ_λ=.393	σ_u=.855; σ_λ=.495	σ_u=.812; σ_λ=.507
CAMERA ON-TIME	σ_u=.00115; σ_λ=.00008	σ_u=.00127; σ_λ=.00018	σ_u=.00115; σ_λ=.00011	σ_u=.00126; σ_λ=.00009	σ_u=.00126; σ_λ=.00010	σ_u=.00126; σ_λ=.00012	σ_u=.00115; σ_λ=.00006	σ_u=.00129; σ_λ=.00001	σ_u=.00128; σ_λ=.00009
MOON RADIUS	σ_u=.00002; σ_λ=.00175	σ_u=.00643; σ_λ=.00206	σ_u=.00039; σ_λ=.00088	σ_u=.00681; σ_λ=.00315	σ_u=.00564; σ_λ=.00134	σ_u=.00660; σ_λ=.00316	σ_u=.00142; σ_λ=.00238	σ_u=.00683; σ_λ=.00234	σ_u=.00668; σ_λ=.00230

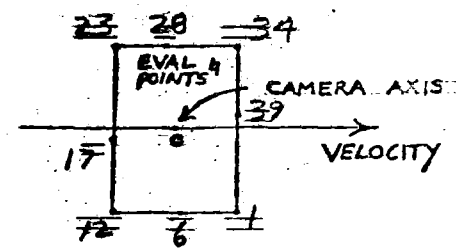
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.832° 25.2 KM; σ_λ=.406° 12.3 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=.591° 17.9 KM; σ_λ=.788° 23.9 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=4.17° 126. KM; σ_λ=.646° 19.6 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=1.35° 40.9 KM; σ_λ=1.01° 30.6 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=5.44° 165. KM; σ_λ=1.57° 47.5 KM
NAVIGATION	σ_u=0; σ_λ=0	σ_u=; σ_λ=	σ_u=0; σ_λ=0	σ_u=; σ_λ=	σ_u=0; σ_λ=0	σ_u=; σ_λ=	σ_u=0; σ_λ=0	σ_u=; σ_λ=	σ_u=0; σ_λ=0
ATTITUDE	σ_u=.832; σ_λ=.406	σ_u=; σ_λ=	σ_u=.591; σ_λ=.788	σ_u=; σ_λ=	σ_u=4.17; σ_λ=.646	σ_u=; σ_λ=	σ_u=1.35; σ_λ=1.01	σ_u=; σ_λ=	σ_u=5.44; σ_λ=1.57
CAMERA ON-TIME	σ_u=.00115; σ_λ=.00008	σ_u=; σ_λ=	σ_u=.00112; σ_λ=.00032	σ_u=; σ_λ=	σ_u=.00165; σ_λ=.00060	σ_u=; σ_λ=	σ_u=.00116; σ_λ=.00006	σ_u=; σ_λ=	σ_u=.00451; σ_λ=.00026
MOON RADIUS	σ_u=.00002; σ_λ=.00175	σ_u=; σ_λ=	σ_u=.00231; σ_λ=.0166	σ_u=; σ_λ=	σ_u=.0534; σ_λ=.00714	σ_u=; σ_λ=	σ_u=.00399; σ_λ=.0255	σ_u=; σ_λ=	σ_u=.0507; σ_λ=.00595

* μ = LATITUDE λ = LONGITUDE

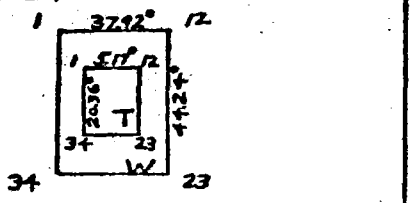
ERROR ANALYSIS RESULTS MISSION IV FRAME 75





S/C ALTITUDE = 6125 KM
TRUE ANOMALY = 179. °
INCLINATION ≈ 95. °
NOTE: R(-192°) P(-[illegible]) Y(0°)
CELESTIAL ALIGNMENT

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

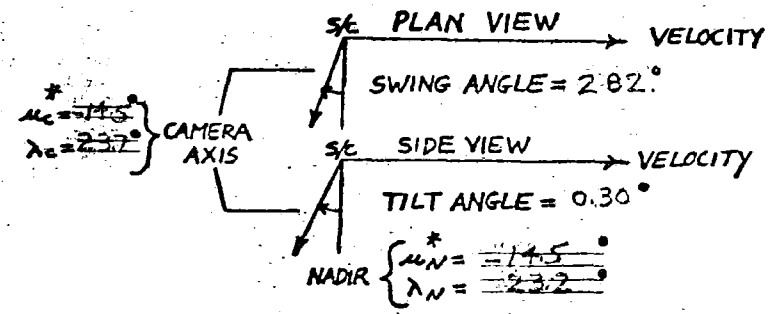
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u=.826° 25.0 KM ∇_λ=.434° 13.1 KM	∇_u=1.51° 45.7 KM ∇_λ=1.07° 32.4 KM	∇_u=.793° 24.0 KM ∇_λ=.453° 13.7 KM	∇_u=ND° KM ∇_λ=ND° KM	∇_u=ND° KM ∇_λ=ND° KM	∇_u=ND° KM ∇_λ=ND° KM	∇_u=.871° 26.4 KM ∇_λ=.441° 13.3 KM	∇_u=1.62° 49.1 KM ∇_λ=.693° 21.0 KM	∇_u=1.53° 46.4 KM ∇_λ=.720° 21.8 KM
NAVIGATION	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0	∇_u=0 ∇_λ=0
ATTITUDE	∇_u=.826 ∇_λ=.434	∇_u=1.51 ∇_λ=1.07	∇_u=.793 ∇_λ=.454	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u=.871 ∇_λ=.441	∇_u=1.62 ∇_λ=.693	∇_u=1.53 ∇_λ=.720
CAMERA ON-TIME	∇_u=.00065 ∇_λ=.00005	∇_u=.00106 ∇_λ=.00026	∇_u=.00065 ∇_λ=.00004	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u=.00065 ∇_λ=.00004	∇_u=.00107 ∇_λ=.00030	∇_u=.00105 ∇_λ=.00004
MOON RADIUS	∇_u=.00013 ∇_λ=.00033	∇_u=.0174 ∇_λ=.00970	∇_u=.00982 ∇_λ=.00311	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u=.0107 ∇_λ=.00241	∇_u=.0172 ∇_λ=.00634	∇_u=.0168 ∇_λ=.00052

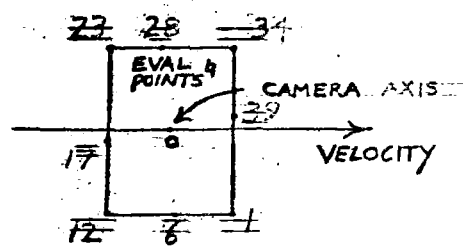
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u=.857° 26.9 KM ∇_λ=.446° 13.5 KM	∇_u=ND° KM ∇_λ=ND° KM	∇_u=ND° KM ∇_λ=ND° KM	∇_u=ND° KM ∇_λ=ND° KM	∇_u=ND° KM ∇_λ=ND° KM	∇_u=ND° KM ∇_λ=ND° KM	∇_u=ND° KM ∇_λ=ND° KM	∇_u=ND° KM ∇_λ=ND° KM	∇_u=ND° KM ∇_λ=ND° KM
NAVIGATION	∇_u=0 ∇_λ=0	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=
ATTITUDE	∇_u=.857 ∇_λ=.446	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=
CAMERA ON-TIME	∇_u=.00065 ∇_λ=.00005	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=
MOON RADIUS	∇_u=.00013 ∇_λ=.00033	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=	∇_u= ∇_λ=

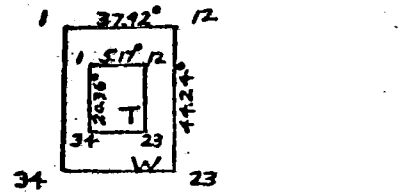
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION IV FRAME 84





S/C ALTITUDE = 2725 KM
TRUE ANOMALY = 345°
INCLINATION ≈ 85°
NOTE: APOLLO 9 FLT
3RD OF SERIES



TELEPHOTO LENS, T

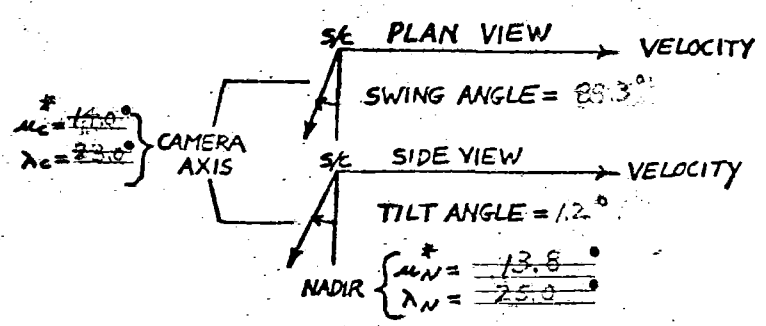
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.529° 16.0 KM; σ_λ=.289° 8.75 KM	σ_u=.610° 18.5 KM; σ_λ=.297° 9.00 KM	σ_u=.506° 15.3 KM; σ_λ=.289° 8.75 KM	σ_u=.574° 17.4 KM; σ_λ=.414° 12.5 KM	σ_u=.603° 18.2 KM; σ_λ=.390° 11.8 KM	σ_u=.641° 19.4 KM; σ_λ=.372° 11.3 KM	σ_u=.555° 16.8 KM; σ_λ=.293° 8.88 KM	σ_u=.656° 19.9 KM; σ_λ=.290° 8.79 KM	σ_u=.633° 19.2 KM; σ_λ=.290° 8.79 KM
NAVIGATION	σ_u=0	σ_λ=0	σ_u=0	σ_λ=0	σ_u=0	σ_λ=0	σ_u=0	σ_λ=0	σ_u=0	σ_λ=0	σ_u=0	σ_λ=0	σ_u=0	σ_λ=0	σ_u=0	σ_λ=0
ATTITUDE	σ_u=.529	σ_λ=.289	σ_u=.610	σ_λ=.297	σ_u=.506	σ_λ=.289	σ_u=.574	σ_λ=.414	σ_u=.603	σ_λ=.390	σ_u=.640	σ_λ=.372	σ_u=.555	σ_λ=.293	σ_u=.656	σ_λ=.290	σ_u=.632	σ_λ=.290
CAMERA ON-TIME	σ_u=.00115	σ_λ=.00008	σ_u=.00126	σ_λ=.00010	σ_u=.00115	σ_λ=.00006	σ_u=.00128	σ_λ=.00008	σ_u=.00128	σ_λ=.00005	σ_u=.00129	σ_λ=.00015	σ_u=.00115	σ_λ=.00011	σ_u=.00125	σ_λ=.00006	σ_u=.00125	σ_λ=.00008
MOON RADIUS	σ_u=.00002	σ_λ=.00018	σ_u=.00684	σ_λ=.00123	σ_u=.00670	σ_λ=.00168	σ_u=.00646	σ_λ=.00329	σ_u=.00665	σ_λ=.00127	σ_u=.00685	σ_λ=.00116	σ_u=.00668	σ_λ=.00136	σ_u=.00652	σ_λ=.00203	σ_u=.00661	σ_λ=.00055

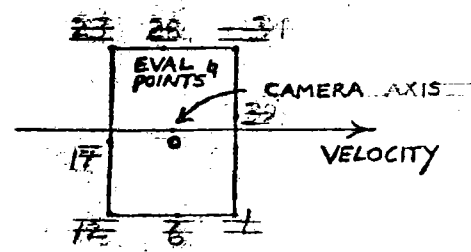
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.626° 19.0 KM; σ_λ=.301° 9.11 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=.509° 15.4 KM; σ_λ=.665° 20.2 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=2.92° 88.5 KM; σ_λ=4.19° 127. KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=.971° 29.4 KM; σ_λ=.632° 19.1 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=3.71° 112. KM; σ_λ=.633° 19.1 KM
NAVIGATION	σ_u=0	σ_λ=0	σ_u=	σ_λ=	σ_u=0	σ_λ=0	σ_u=	σ_λ=	σ_u=0	σ_λ=0	σ_u=	σ_λ=	σ_u=0	σ_λ=0	σ_u=	σ_λ=	σ_u=0	σ_λ=0
ATTITUDE	σ_u=.626	σ_λ=.301	σ_u=	σ_λ=	σ_u=.508	σ_λ=.665	σ_u=	σ_λ=	σ_u=2.92	σ_λ=4.19	σ_u=	σ_λ=	σ_u=.971	σ_λ=.632	σ_u=	σ_λ=	σ_u=3.71	σ_λ=.633
CAMERA ON-TIME	σ_u=.00115	σ_λ=.00008	σ_u=	σ_λ=	σ_u=.00121	σ_λ=.00014	σ_u=	σ_λ=	σ_u=.00421	σ_λ=.00438	σ_u=	σ_λ=	σ_u=.00111	σ_λ=.00059	σ_u=	σ_λ=	σ_u=.00390	σ_λ=.00061
MOON RADIUS	σ_u=.00002	σ_λ=.00018	σ_u=	σ_λ=	σ_u=.00630	σ_λ=.0202	σ_u=	σ_λ=	σ_u=.0477	σ_λ=.0563	σ_u=	σ_λ=	σ_u=.00067	σ_λ=.0201	σ_u=	σ_λ=	σ_u=.0465	σ_λ=.0110

* u = LATITUDE λ = LONGITUDE

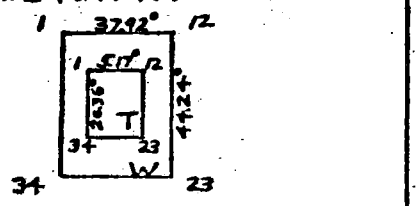
ERROR ANALYSIS RESULTS MISSION IV FRAME 85





S/C ALTITUDE = ~~275~~ KM
TRUE ANOMALY = ~~13.0~~ °
INCLINATION ≈ ~~85~~ °
NOTE: ~~APOLLO~~ 4TH OF SERIES

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

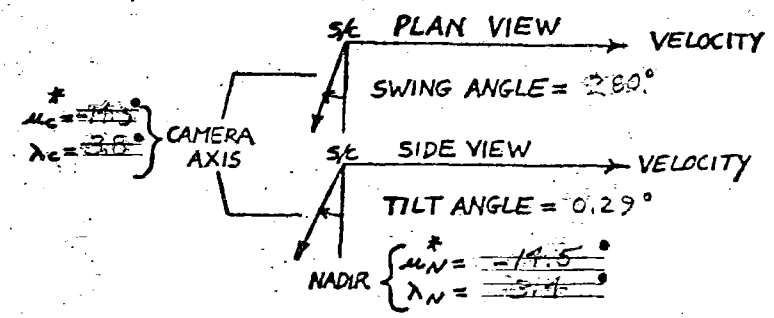
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.638° 19.3 KM; σ_λ=.333° 10.1 KM	σ_u=.692° 21.0 KM; σ_λ=.470° 14.2 KM	σ_u=.604° 18.3 KM; σ_λ=.340° 10.3 KM	σ_u=.724° 21.9 KM; σ_λ=.335° 10.1 KM	σ_u=.751° 22.8 KM; σ_λ=.332° 10.1 KM	σ_u=.789° 23.9 KM; σ_λ=.337° 10.2 KM	σ_u=.674° 20.4 KM; σ_λ=.335° 10.2 KM	σ_u=.780° 23.6 KM; σ_λ=.430° 13.0 KM	σ_u=.738° 22.4 KM; σ_λ=.444° 13.4 KM
NAVIGATION	σ_u= 0; σ_λ= 0	σ_u= 0; σ_λ= 0	σ_u= 0; σ_λ= 0	σ_u= 0; σ_λ= 0	σ_u= 0; σ_λ= 0	σ_u= 0; σ_λ= 0	σ_u= 0; σ_λ= 0	σ_u= 0; σ_λ= 0	σ_u= 0; σ_λ= 0
ATTITUDE	σ_u=.638; σ_λ=.333	σ_u=.692; σ_λ=.470	σ_u=.604; σ_λ=.340	σ_u=.724; σ_λ=.335	σ_u=.751; σ_λ=.332	σ_u=.789; σ_λ=.337	σ_u=.674; σ_λ=.335	σ_u=.780; σ_λ=.430	σ_u=.738; σ_λ=.444
CAMERA ON-TIME	σ_u=.00115; σ_λ=.00007	σ_u=.00128; σ_λ=.00018	σ_u=.00115; σ_λ=.00010	σ_u=.00126; σ_λ=.00008	σ_u=.00126; σ_λ=.00010	σ_u=.00126; σ_λ=.00012	σ_u=.00115; σ_λ=.00005	σ_u=.00129; σ_λ= 0	σ_u=.00128; σ_λ=.00008
MOON RADIUS	σ_u=.00005; σ_λ=.00075	σ_u=.00646; σ_λ=.00202	σ_u=.00043; σ_λ=.00087	σ_u=.00675; σ_λ=.00216	σ_u=.00660; σ_λ=.00131	σ_u=.00655; σ_λ=.00313	σ_u=.00339; σ_λ=.00238	σ_u=.00630; σ_λ=.00239	σ_u=.00671; σ_λ=.00034

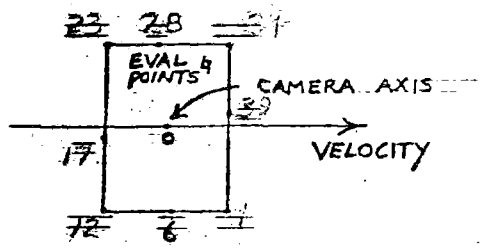
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.756° 22.9 KM; σ_λ=.348° 10.5 KM	σ_u=.ND° KM; σ_λ=.ND° KM	σ_u=.507° 15.4 KM; σ_λ=.674° 20.4 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=3.57° 108. KM; σ_λ=.543° 16.4 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=1.25° 37.9 KM; σ_λ=.859° 26.0 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=4.93° 149. KM; σ_λ=1.34° 40.6 KM
NAVIGATION	σ_u= 0; σ_λ= 0	σ_u=; σ_λ=	σ_u= 0; σ_λ= 0	σ_u=; σ_λ=	σ_u= 0; σ_λ= 0	σ_u=; σ_λ=	σ_u= 0; σ_λ= 0	σ_u=; σ_λ=	σ_u= 0; σ_λ= 0
ATTITUDE	σ_u=.756; σ_λ=.348	σ_u=; σ_λ=	σ_u=.507; σ_λ=.674	σ_u=; σ_λ=	σ_u=3.56; σ_λ=.543	σ_u=; σ_λ=	σ_u=1.25; σ_λ=.858	σ_u=; σ_λ=	σ_u=4.93; σ_λ=1.34
CAMERA ON-TIME	σ_u=.00115; σ_λ=.00007	σ_u=; σ_λ=	σ_u=.00112; σ_λ=.00032	σ_u=; σ_λ=	σ_u=.00403; σ_λ=.00053	σ_u=; σ_λ=	σ_u=.00116; σ_λ=.00007	σ_u=; σ_λ=	σ_u=.00452; σ_λ=.00039
MOON RADIUS	σ_u=.00005; σ_λ=.00075	σ_u=; σ_λ=	σ_u=.00220; σ_λ=.0167	σ_u=; σ_λ=	σ_u=.0472; σ_λ=.00626	σ_u=; σ_λ=	σ_u=.00399; σ_λ=.0253	σ_u=; σ_λ=	σ_u=.0509; σ_λ=.00737

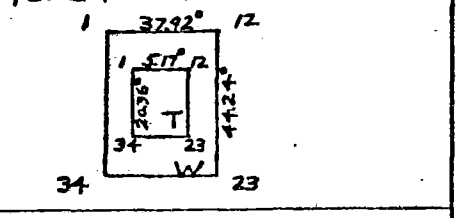
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION IV FRAME 101





S/C ALTITUDE = 2719 KM
TRUE ANOMALY = 343 °
INCLINATION ≈ 85 °
NOTE: APOLLO EPHEMERIS
2ND OF SERIES



TELEPHOTO LENS, T

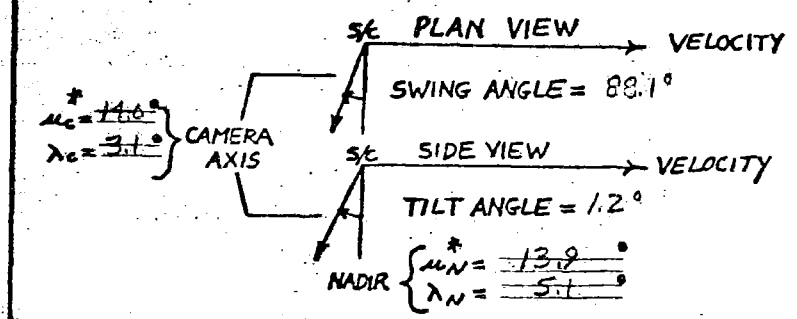
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.487° 14.8 KM; σ_λ=.240° 7.27 KM	σ_u=.559° 16.9 KM; σ_λ=.254° 7.70 KM	σ_u=.461° 14.0 KM; σ_λ=.240° 7.28 KM	σ_u=.520° 15.7 KM; σ_λ=.371° 11.2 KM	σ_u=.552° 16.7 KM; σ_λ=.348° 10.5 KM	σ_u=.593° 17.9 KM; σ_λ=.327° 9.90 KM	σ_u=.516° 15.6 KM; σ_λ=.244° 7.40 KM	σ_u=.610° 18.5 KM; σ_λ=.245° 7.43 KM	σ_u=.585° 17.7 KM; σ_λ=.246° 7.45 KM
NAVIGATION	σ_u=.00192; σ_λ=.00271	σ_u=.00222; σ_λ=.00267	σ_u=.00197; σ_λ=.00269	σ_u=.00209; σ_λ=.00294	σ_u=.00209; σ_λ=.00301	σ_u=.00208; σ_λ=.00316	σ_u=.00188; σ_λ=.00278	σ_u=.00203; σ_λ=.00261	σ_u=.00211; σ_λ=.00262
ATTITUDE	σ_u=.487; σ_λ=.240	σ_u=.559; σ_λ=.253	σ_u=.461; σ_λ=.240	σ_u=.520; σ_λ=.371	σ_u=.552; σ_λ=.348	σ_u=.592; σ_λ=.327	σ_u=.516; σ_λ=.244	σ_u=.610; σ_λ=.245	σ_u=.585; σ_λ=.246
CAMERA ON-TIME	σ_u=.00115; σ_λ=.00008	σ_u=.00126; σ_λ=.00009	σ_u=.00115; σ_λ=.00006	σ_u=.00128; σ_λ=.00004	σ_u=.00128; σ_λ=.00004	σ_u=.00129; σ_λ=.00014	σ_u=.00115; σ_λ=.00011	σ_u=.00125; σ_λ=.00006	σ_u=.00125; σ_λ=.00007
MOON RADIUS	σ_u=.00001; σ_λ=.00017	σ_u=.00684; σ_λ=.00119	σ_u=.00071; σ_λ=.00167	σ_u=.00643; σ_λ=.00129	σ_u=.00663; σ_λ=.00129	σ_u=.00684; σ_λ=.00114	σ_u=.00068; σ_λ=.00137	σ_u=.00651; σ_λ=.00206	σ_u=.00660; σ_λ=.00058

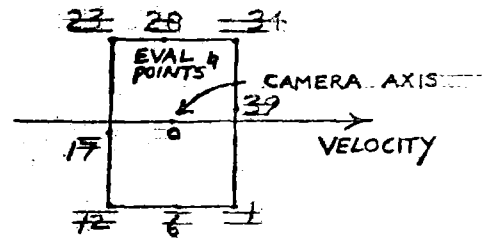
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.577° 17.5 KM; σ_λ=.251° 7.60 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=.422° 12.8 KM; σ_λ=.547° 16.6 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=2.60° 79.3 KM; σ_λ=3.86° 117. KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=.943° 28.6 KM; σ_λ=.526° 16.0 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=3.35° 101. KM; σ_λ=.506° 15.3 KM
NAVIGATION	σ_u=.00192; σ_λ=.00271	σ_u=; σ_λ=	σ_u=.00294; σ_λ=.00480	σ_u=; σ_λ=	σ_u=.00467; σ_λ=.00493	σ_u=; σ_λ=	σ_u=.00141; σ_λ=.00501	σ_u=; σ_λ=	σ_u=.00686; σ_λ=.00200
ATTITUDE	σ_u=.577; σ_λ=.251	σ_u=; σ_λ=	σ_u=.422; σ_λ=.547	σ_u=; σ_λ=	σ_u=2.60; σ_λ=3.86	σ_u=; σ_λ=	σ_u=.943; σ_λ=.525	σ_u=; σ_λ=	σ_u=3.35; σ_λ=.506
CAMERA ON-TIME	σ_u=.00115; σ_λ=.00008	σ_u=; σ_λ=	σ_u=.00121; σ_λ=.00013	σ_u=; σ_λ=	σ_u=.00410; σ_λ=.00417	σ_u=; σ_λ=	σ_u=.00111; σ_λ=.00059	σ_u=; σ_λ=	σ_u=.00384; σ_λ=.00061
MOON RADIUS	σ_u=.00001; σ_λ=.00017	σ_u=↓; σ_λ=↓	σ_u=.00632; σ_λ=.0200	σ_u=↓; σ_λ=↓	σ_u=.0462; σ_λ=.0537	σ_u=↓; σ_λ=↓	σ_u=.00013; σ_λ=.0201	σ_u=↓; σ_λ=↓	σ_u=.04581; σ_λ=.0111

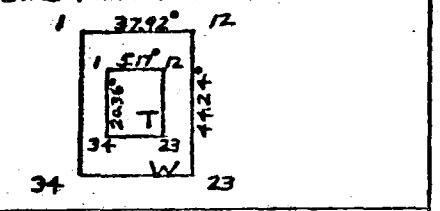
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION IV FRAME 102





S/C ALTITUDE = 2697 KM
TRUE ANOMALY = 11.7°
INCLINATION ≈ 95°
NOTE: APOLLO ERASE
3RD OF SERIES



TELEPHOTO LENS, T

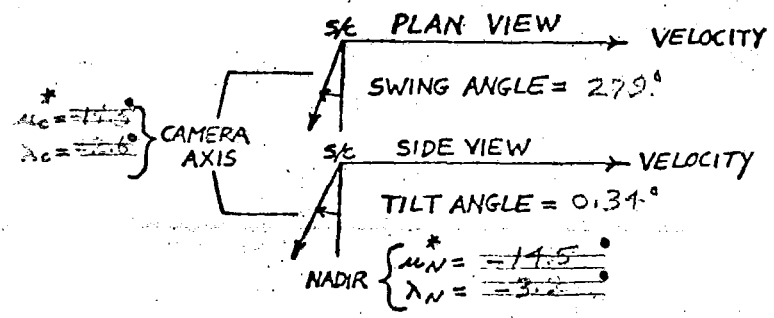
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.595° 18.0 KM; σ_λ=.290° 8.80 KM	σ_μ=.639° 19.3 KM; σ_λ=.429° 13.0 KM	σ_μ=.560° 17.0 KM; σ_λ=.296° 8.97 KM	σ_μ=.671° 20.3 KM; σ_λ=.298° 9.03 KM	σ_μ=.700° 21.2 KM; σ_λ=.293° 8.88 KM	σ_μ=.740° 22.4 KM; σ_λ=.296° 8.97 KM	σ_μ=.633° 19.2 KM; σ_λ=.291° 8.81 KM	σ_μ=.729° 22.0 KM; σ_λ=.386° 11.7 KM	σ_μ=.686° 20.8 KM; σ_λ=.402° 12.2 KM
NAVIGATION	σ_μ=.00223; σ_λ=.00355	σ_μ=.00252; σ_λ=.00381	σ_μ=.00229; σ_λ=.00352	σ_μ=.00247; σ_λ=.00343	σ_μ=.00236; σ_λ=.00342	σ_μ=.00223; σ_λ=.00345	σ_μ=.00216; σ_λ=.00361	σ_μ=.00251; σ_λ=.00419	σ_μ=.00252; σ_λ=.00399
ATTITUDE	σ_μ=.595; σ_λ=.290	σ_μ=.639; σ_λ=.429	σ_μ=.560; σ_λ=.296	σ_μ=.671; σ_λ=.298	σ_μ=.700; σ_λ=.293	σ_μ=.740; σ_λ=.296	σ_μ=.633; σ_λ=.291	σ_μ=.729; σ_λ=.386	σ_μ=.686; σ_λ=.402
CAMERA ON-TIME	σ_μ=.00116; σ_λ=.00007	σ_μ=.00128; σ_λ=.00017	σ_μ=.00116; σ_λ=.00010	σ_μ=.00127; σ_λ=.00008	σ_μ=.00126; σ_λ=.00009	σ_μ=.00126; σ_λ=.00011	σ_μ=.00116; σ_λ=.00005	σ_μ=.00129; σ_λ= 0	σ_μ=.00129; σ_λ=.00008
MOON RADIUS	σ_μ=.00004; σ_λ=.00075	σ_μ=.00643; σ_λ=.00197	σ_μ=.00043; σ_λ=.00087	σ_μ=.00672; σ_λ=.00119	σ_μ=.00638; σ_λ=.00128	σ_μ=.00653; σ_λ=.00309	σ_μ=.00040; σ_λ=.00237	σ_μ=.00685; σ_λ=.00241	σ_μ=.00667; σ_λ=.00038

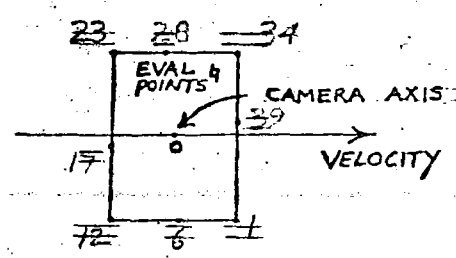
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.705° 21.4 KM; σ_λ=.303° 9.18 KM	σ_μ= ND° KM; σ_λ= ND° KM	σ_μ=.438° 13.3 KM; σ_λ=.584° 17.7 KM	σ_μ= ND° KM; σ_λ= ND° KM	σ_μ=3.18° 96.5 KM; σ_λ=.498° 15.1 KM	σ_μ= ND° KM; σ_λ= ND° KM	σ_μ=1.20° 36.4 KM; σ_λ=.736° 22.3 KM	σ_μ= ND° KM; σ_λ= ND° KM	σ_μ=4.14° 125. KM; σ_λ=1.24° 37.6 KM
NAVIGATION	σ_μ=.00223; σ_λ=.00355	σ_μ=; σ_λ=	σ_μ=.00293; σ_λ=.00492	σ_μ=; σ_λ=	σ_μ=.00504; σ_λ=.00410	σ_μ=; σ_λ=	σ_μ=.00115; σ_λ=.00727	σ_μ=; σ_λ=	σ_μ=.00862; σ_λ=.00950
ATTITUDE	σ_μ=.705; σ_λ=.303	σ_μ=; σ_λ=	σ_μ=.438; σ_λ=.584	σ_μ=; σ_λ=	σ_μ=3.18; σ_λ=.498	σ_μ=; σ_λ=	σ_μ=1.20; σ_λ=.736	σ_μ=; σ_λ=	σ_μ=4.14; σ_λ=1.24
CAMERA ON-TIME	σ_μ=.00116; σ_λ=.00007	σ_μ=; σ_λ=	σ_μ=.00112; σ_λ=.00032	σ_μ=; σ_λ=	σ_μ=.00385; σ_λ=.00047	σ_μ=; σ_λ=	σ_μ=.00116; σ_λ=.00007	σ_μ=; σ_λ=	σ_μ=.00425; σ_λ=.00042
MOON RADIUS	σ_μ=.00004; σ_λ=.00075	σ_μ=; σ_λ=	σ_μ=.00211; σ_λ=.0165	σ_μ=; σ_λ=	σ_μ=.0449; σ_λ=.00557	σ_μ=; σ_λ=	σ_μ=.00391; σ_λ=.0248	σ_μ=; σ_λ=	σ_μ=.0477; σ_λ=.00762

* μ = LATITUDE λ = LONGITUDE

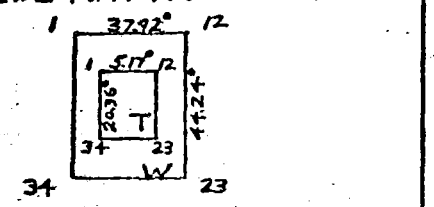
ERROR ANALYSIS RESULTS MISSION IV FRAME 108





S/C ALTITUDE = 271.7 KM
TRUE ANOMALY = 343.
INCLINATION ≈ 85.
NOTE: APOLLO FRAME 3RD OF SERIES

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

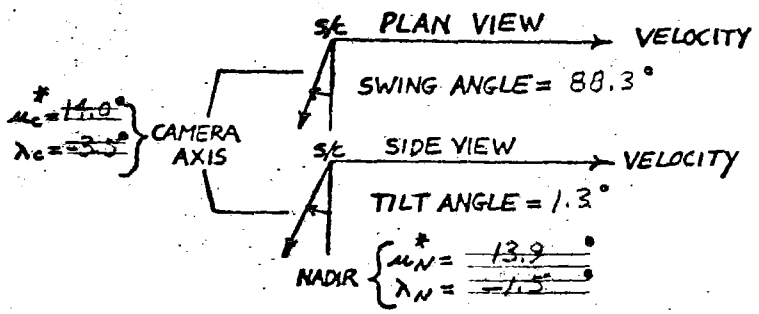
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.529° 16.0 KM; σ_λ=.294° 8.90 KM	σ_u=.608° 18.4 KM; σ_λ=.302° 9.15 KM	σ_u=.504° 15.3 KM; σ_λ=.294° 8.90 KM	σ_u=.570° 17.3 KM; σ_λ=.420° 12.7 KM	σ_u=.599° 18.1 KM; σ_λ=.397° 12.0 KM	σ_u=.637° 19.3 KM; σ_λ=.379° 11.5 KM	σ_u=.553° 16.8 KM; σ_λ=.299° 9.06 KM	σ_u=.653° 19.8 KM; σ_λ=.295° 8.94 KM	σ_u=.631° 19.1 KM; σ_λ=.294° 8.90 KM
NAVIGATION	σ_u=.00026; σ_λ=.00485	σ_u=.00026; σ_λ=.00471	σ_u=.00023; σ_λ=.00485	σ_u=.00027; σ_λ=.00559	σ_u=.00029; σ_λ=.00552	σ_u=.00031; σ_λ=.00552	σ_u=.00031; σ_λ=.00491	σ_u=.00045; σ_λ=.00474	σ_u=.00034; σ_λ=.00470
ATTITUDE	σ_u=.527; σ_λ=.294	σ_u=.608; σ_λ=.301	σ_u=.504; σ_λ=.294	σ_u=.570; σ_λ=.420	σ_u=.599; σ_λ=.397	σ_u=.637; σ_λ=.379	σ_u=.553; σ_λ=.299	σ_u=.653; σ_λ=.295	σ_u=.630; σ_λ=.294
CAMERA ON-TIME	σ_u=.00115; σ_λ=.00008	σ_u=.00126; σ_λ=.00009	σ_u=.00115; σ_λ=.00006	σ_u=.00128; σ_λ=.00004	σ_u=.00128; σ_λ=.00004	σ_u=.00129; σ_λ=.00014	σ_u=.00115; σ_λ=.00011	σ_u=.00125; σ_λ=.00006	σ_u=.00125; σ_λ=.00007
MOON RADIUS	σ_u=.00001; σ_λ=.00020	σ_u=.00684; σ_λ=.00122	σ_u=.00071; σ_λ=.00170	σ_u=.00642; σ_λ=.00334	σ_u=.00662; σ_λ=.00133	σ_u=.00683; σ_λ=.00109	σ_u=.00068; σ_λ=.00133	σ_u=.00650; σ_λ=.00203	σ_u=.00660; σ_λ=.00056

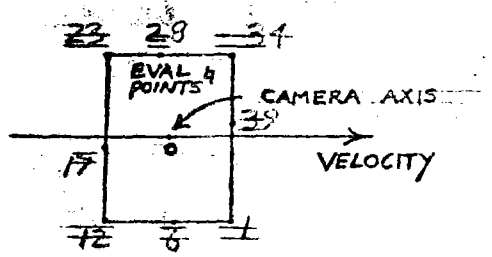
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.623° 18.9 KM; σ_λ=.306° 9.27 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=.507° 15.4 KM; σ_λ=.676° 20.5 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=2.81° 85.1 KM; σ_λ=4.04° 122. KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=.968° 29.3 KM; σ_λ=.636° 19.3 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=3.60° 109. KM; σ_λ=.627° 19.0 KM
NAVIGATION	σ_u=.00026; σ_λ=.00485	σ_u=; σ_λ=	σ_u=.00152; σ_λ=.00825	σ_u=; σ_λ=	σ_u=.00404; σ_λ=.0218	σ_u=; σ_λ=	σ_u=.00105; σ_λ=.00792	σ_u=; σ_λ=	σ_u=.00163; σ_λ=.00615
ATTITUDE	σ_u=.623; σ_λ=.306	σ_u=; σ_λ=	σ_u=.507; σ_λ=.676	σ_u=; σ_λ=	σ_u=2.81; σ_λ=4.04	σ_u=; σ_λ=	σ_u=.968; σ_λ=.636	σ_u=; σ_λ=	σ_u=3.60; σ_λ=.627
CAMERA ON-TIME	σ_u=.00115; σ_λ=.00008	σ_u=; σ_λ=	σ_u=.00121; σ_λ=.00013	σ_u=; σ_λ=	σ_u=.00408; σ_λ=.00420	σ_u=; σ_λ=	σ_u=.00112; σ_λ=.00058	σ_u=; σ_λ=	σ_u=.00382; σ_λ=.00060
MOON RADIUS	σ_u=.00001; σ_λ=.00020	σ_u=; σ_λ=	σ_u=.00638; σ_λ=.0201	σ_u=; σ_λ=	σ_u=.0460; σ_λ=.0540	σ_u=; σ_λ=	σ_u=.00161; σ_λ=.0199	σ_u=; σ_λ=	σ_u=.0456; σ_λ=.0109

* μ = LATITUDE λ = LONGITUDE

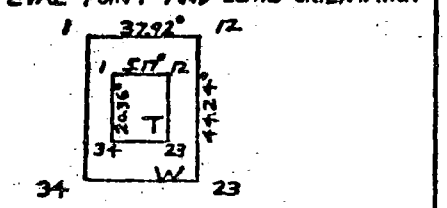
ERROR ANALYSIS RESULTS MISSION IV FRAME 109





S/C ALTITUDE = 2691 KM
TRUE ANOMALY = 11.1 °
INCLINATION ≈ 85 °
NOTE: APOLLO EQUIVALENT
4TH OF SERIES

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

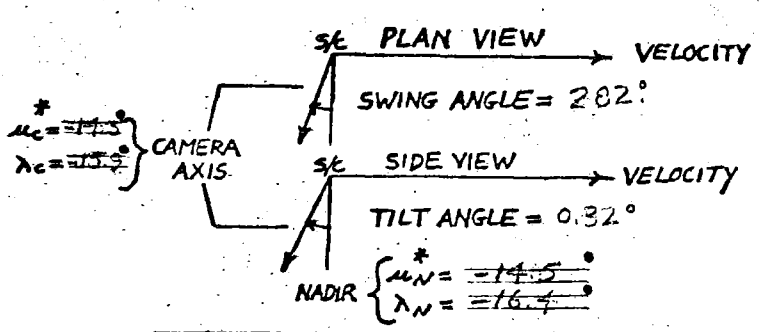
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.632° 19.2 KM; σ_λ=.335° 10.2 KM	σ_u=.685° 20.8 KM; σ_λ=.468° 14.2 KM	σ_u=.599° 18.1 KM; σ_λ=.341° 10.3 KM	σ_u=.715° 21.7 KM; σ_λ=.338° 10.2 KM	σ_u=.742° 22.5 KM; σ_λ=.335° 10.1 KM	σ_u=.780° 23.6 KM; σ_λ=.340° 10.3 KM	σ_u=.668° 20.2 KM; σ_λ=.337° 10.2 KM	σ_u=.772° 23.4 KM; σ_λ=.429° 13.0 KM	σ_u=.731° 22.2 KM; σ_λ=.442° 13.4 KM
NAVIGATION	σ_u=.00030; σ_λ=.00270	σ_u=.00037; σ_λ=.00303	σ_u=.00032; σ_λ=.00271	σ_u=.00031; σ_λ=.00262	σ_u=.00028; σ_λ=.00262	σ_u=.00029; σ_λ=.00267	σ_u=.00029; σ_λ=.00272	σ_u=.00036; σ_λ=.00307	σ_u=.00036; σ_λ=.00303
ATTITUDE	σ_u=.632 σ_λ=.335	σ_u=.685 σ_λ=.468	σ_u=.599 σ_λ=.341	σ_u=.715 σ_λ=.338	σ_u=.742 σ_λ=.335	σ_u=.780 σ_λ=.340	σ_u=.668 σ_λ=.337	σ_u=.772 σ_λ=.429	σ_u=.731 σ_λ=.442
CAMERA ON-TIME	σ_u=.00116; σ_λ=.00007	σ_u=.00128; σ_λ=.00017	σ_u=.00116; σ_λ=.00009	σ_u=.00127; σ_λ=.00007	σ_u=.00127; σ_λ=.00009	σ_u=.00127; σ_λ=.00011	σ_u=.00116; σ_λ=.00005	σ_u=.00129; σ_λ=.00001	σ_u=.00129; σ_λ=.00007
MOON RADIUS	σ_u=.00005; σ_λ=.00076	σ_u=.00643; σ_λ=.00194	σ_u=.00043; σ_λ=.00085	σ_u=.00670; σ_λ=.00018	σ_u=.00656; σ_λ=.00129	σ_u=.00651; σ_λ=.00309	σ_u=.00040; σ_λ=.00238	σ_u=.00684; σ_λ=.00242	σ_u=.00666; σ_λ=.00039

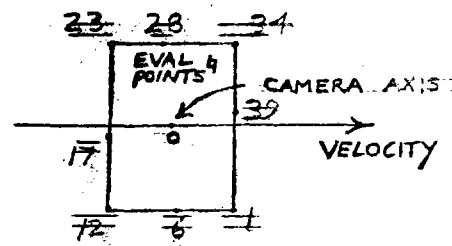
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.749° 22.7 KM; σ_λ=.349° 10.6 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=.502° 15.2 KM; σ_λ=.659° 20.2 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=3.31° 100. KM; σ_λ=.544° 16.5 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=1.24° 37.6 KM; σ_λ=.850° 25.7 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=4.34° 131. KM; σ_λ=1.26° 38.2 KM
NAVIGATION	σ_u=.00030; σ_λ=.00270	σ_u= σ_λ=	σ_u=.00069; σ_λ=.00403	σ_u= σ_λ=	σ_u=.00468; σ_λ=.00308	σ_u= σ_λ=	σ_u=.00078; σ_λ=.00517	σ_u= σ_λ=	σ_u=.00354; σ_λ=.00612
ATTITUDE	σ_u=.749 σ_λ=.349	σ_u= σ_λ=	σ_u=.502 σ_λ=.668	σ_u= σ_λ=	σ_u=3.31 σ_λ=.544	σ_u= σ_λ=	σ_u=1.24 σ_λ=.850	σ_u= σ_λ=	σ_u=4.34 σ_λ=1.26
CAMERA ON-TIME	σ_u=.00116; σ_λ=.00007	σ_u= σ_λ=	σ_u=.00113; σ_λ=.00031	σ_u= σ_λ=	σ_u=.00379; σ_λ=.00045	σ_u= σ_λ=	σ_u=.00116; σ_λ=.00008	σ_u= σ_λ=	σ_u=.00419; σ_λ=.00049
MOON RADIUS	σ_u=.00005; σ_λ=.00076	σ_u= σ_λ=	σ_u=.00208; σ_λ=.0164	σ_u= σ_λ=	σ_u=.0440; σ_λ=.00543	σ_u= σ_λ=	σ_u=.00395; σ_λ=.0248	σ_u= σ_λ=	σ_u=.0470; σ_λ=.00768

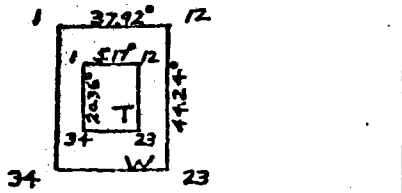
* σ_u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION IV FRAME 120





s/c ALTITUDE = 2716. KM
TRUE ANOMALY = 342. °
INCLINATION ≈ 85. °
NOTE: APOLLO STATE
3RD OF SERIES



TELEPHOTO LENS, T

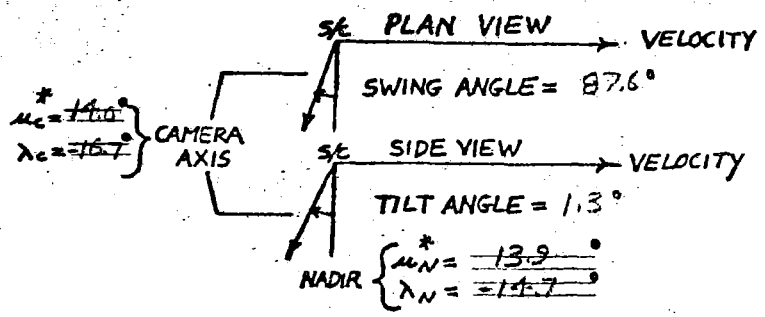
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.527° 16.0 KM; σ_λ=.289° 8.75 KM	σ_u=.608° 18.4 KM; σ_λ=.296° 8.97 KM	σ_u=.504° 15.3 KM; σ_λ=.289° 8.75 KM	σ_u=.571° 17.3 KM; σ_λ=.415° 12.6 KM	σ_u=.601° 18.2 KM; σ_λ=.392° 11.9 KM	σ_u=.639° 19.3 KM; σ_λ=.373° 11.3 KM	σ_u=.554° 16.8 KM; σ_λ=.293° 8.88 KM	σ_u=.654° 19.8 KM; σ_λ=.290° 8.79 KM	σ_u=.631° 19.1 KM; σ_λ=.289° 8.75 KM
NAVIGATION	σ_u=.00119; σ_λ=.00080	σ_u=.00128; σ_λ=.00076	σ_u=.00117; σ_λ=.00081	σ_u=.00131; σ_λ=.00104	σ_u=.001322; σ_λ=.00096	σ_u=.00134; σ_λ=.00086	σ_u=.00120; σ_λ=.00078	σ_u=.00132; σ_λ=.00079	σ_u=.001301; σ_λ=.00077
ATTITUDE	σ_u=.527; σ_λ=.289	σ_u=.608; σ_λ=.296	σ_u=.504; σ_λ=.289	σ_u=.571; σ_λ=.415	σ_u=.601; σ_λ=.392	σ_u=.638; σ_λ=.373	σ_u=.554; σ_λ=.293	σ_u=.654; σ_λ=.290	σ_u=.631; σ_λ=.289
CAMERA ON-TIME	σ_u=.00115; σ_λ=.00008	σ_u=.00126; σ_λ=.00009	σ_u=.00115; σ_λ=.00006	σ_u=.00128; σ_λ=.00014	σ_u=.00129; σ_λ=.00004	σ_u=.00129; σ_λ=.00014	σ_u=.00115; σ_λ=.00011	σ_u=.00124; σ_λ=.00006	σ_u=.00125; σ_λ=.00007
MOON RADIUS	σ_u=.00002; σ_λ=.00019	σ_u=.00682; σ_λ=.00121	σ_u=.00070; σ_λ=.00169	σ_u=.00643; σ_λ=.00331	σ_u=.00663; σ_λ=.00131	σ_u=.00684; σ_λ=.00111	σ_u=.00069; σ_λ=.00135	σ_u=.00649; σ_λ=.00204	σ_u=.00658; σ_λ=.00056

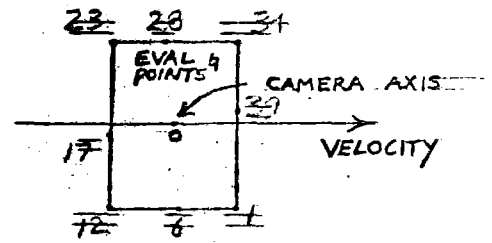
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.624° 18.9 KM; σ_λ=.301° 9.12 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=.506° 15.3 KM; σ_λ=.661° 20.0 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=2.83° 85.7 KM; σ_λ=4.04° 122. KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=.970° 29.4 KM; σ_λ=.627° 19.0 KM	σ_u= ND° KM; σ_λ= ND° KM	σ_u=3.55° 107. KM; σ_λ=.609° 18.4 KM
NAVIGATION	σ_u=.00119; σ_λ=.00080	σ_u=; σ_λ=	σ_u=.00098; σ_λ=.00135	σ_u=; σ_λ=	σ_u=.00492; σ_λ=.00846	σ_u=; σ_λ=	σ_u=.00130; σ_λ=.00091	σ_u=; σ_λ=	σ_u=.00407; σ_λ=.00165
ATTITUDE	σ_u=.624; σ_λ=.301	σ_u=; σ_λ=	σ_u=.506; σ_λ=.661	σ_u=; σ_λ=	σ_u=2.83; σ_λ=4.04	σ_u=; σ_λ=	σ_u=.970; σ_λ=.627	σ_u=; σ_λ=	σ_u=3.55; σ_λ=.609
CAMERA ON-TIME	σ_u=.00115; σ_λ=.00008	σ_u=; σ_λ=	σ_u=.00121; σ_λ=.00012	σ_u=; σ_λ=	σ_u=.00411; σ_λ=.00419	σ_u=; σ_λ=	σ_u=.001111; σ_λ=.00059	σ_u=; σ_λ=	σ_u=.00377; σ_λ=.00058
MOON RADIUS	σ_u=.00002; σ_λ=.00019	σ_u=↓; σ_λ=↓	σ_u=.00632; σ_λ=.0201	σ_u=↓; σ_λ=↓	σ_u=.0462; σ_λ=.0539	σ_u=↓; σ_λ=↓	σ_u=.000151; σ_λ=.0120	σ_u=↓; σ_λ=↓	σ_u=.0450; σ_λ=.0107

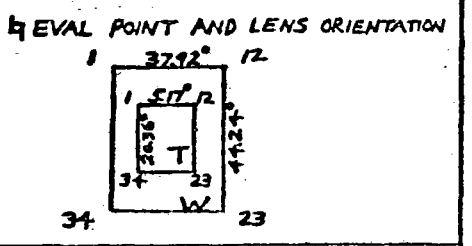
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION IV FRAME 121





S/C ALTITUDE = 2600 KM
TRUE ANOMALY = 10.0 °
INCLINATION ≈ 85 °
NOTE: APOLLO FLT. NO.
4TH OF SERIES



TELEPHOTO LENS, T

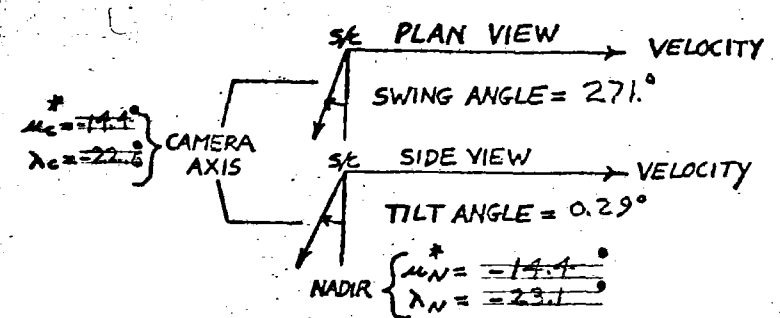
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u=.630° 19.1 KM ∇_λ=.329° 9.98 KM	∇_u=.682° 20.7 KM ∇_λ=.462° 14.0 KM	∇_u=.597° 18.1 KM ∇_λ=.335° 10.2 KM	∇_u=.713° 21.6 KM ∇_λ=.332° 10.1 KM	∇_u=.740° 22.4 KM ∇_λ=.329° 9.98 KM	∇_u=.778° 23.6 KM ∇_λ=.334° 10.1 KM	∇_u=.666° 20.2 KM ∇_λ=.331° 10.0 KM	∇_u=.769° 23.3 KM ∇_λ=.423° 12.8 KM	∇_u=.728° 22.0 KM ∇_λ=.436° 13.2 KM
NAVIGATION	∇_u=.00106 ∇_λ=.00169	∇_u=.00113 ∇_λ=.00197	∇_u=.00103 ∇_λ=.00172	∇_u=.00117 ∇_λ=.00165	∇_u=.00121 ∇_λ=.00167	∇_u=.00126 ∇_λ=.00172	∇_u=.00109 ∇_λ=.00169	∇_u=.00116 ∇_λ=.00185	∇_u=.00115 ∇_λ=.00190
ATTITUDE	∇_u=.630 ∇_λ=.329	∇_u=.682 ∇_λ=.462	∇_u=.597 ∇_λ=.335	∇_u=.713 ∇_λ=.332	∇_u=.740 ∇_λ=.329	∇_u=.778 ∇_λ=.334	∇_u=.666 ∇_λ=.331	∇_u=.769 ∇_λ=.423	∇_u=.728 ∇_λ=.436
CAMERA ON-TIME	∇_u=.00116 ∇_λ=.00007	∇_u=.00128 ∇_λ=.00017	∇_u=.00116 ∇_λ=.00010	∇_u=.00127 ∇_λ=.00008	∇_u=.00127 ∇_λ=.00009	∇_u=.00127 ∇_λ=.00011	∇_u=.00116 ∇_λ=.00005	∇_u=.00130 ∇_λ= 0	∇_u=.00129 ∇_λ=.00008
MOON RADIUS	∇_u=.00004 ∇_λ=.00076	∇_u=.00639 ∇_λ=.01194	∇_u=.00042 ∇_λ=.00085	∇_u=.00669 ∇_λ=.00017	∇_u=.00655 ∇_λ=.00129	∇_u=.00650 ∇_λ=.00310	∇_u=.00040 ∇_λ=.00237	∇_u=.00681 ∇_λ=.00240	∇_u=.00663 ∇_λ=.00039

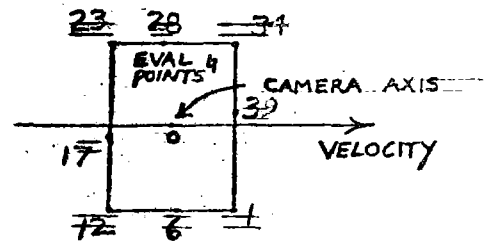
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_u=.746° 22.6 KM ∇_λ=.343° 10.4 KM	∇_u= ND° KM ∇_λ= ND° KM	∇_u=.500° 15.1 KM ∇_λ=.654° 19.8 KM	∇_u= ND° KM ∇_λ= ND° KM	∇_u=3.23° 97.9 KM ∇_λ=.534° 16.2 KM	∇_u= ND° KM ∇_λ= ND° KM	∇_u=1.23° 37.3 KM ∇_λ=.828° 25.1 KM	∇_u= ND° KM ∇_λ= ND° KM	∇_u=4.08° 123. KM ∇_λ=1.26° 38.2 KM
NAVIGATION	∇_u=.00106 ∇_λ=.00169	∇_u= ∇_λ=	∇_u=.00072 ∇_λ=.00266	∇_u= ∇_λ=	∇_u=.00409 ∇_λ=.00246	∇_u= ∇_λ=	∇_u=.00154 ∇_λ=.00306	∇_u= ∇_λ=	∇_u=.00356 ∇_λ=.00356
ATTITUDE	∇_u=.746 ∇_λ=.343	∇_u= ∇_λ=	∇_u=.499 ∇_λ=.654	∇_u= ∇_λ=	∇_u=3.23 ∇_λ=.534	∇_u= ∇_λ=	∇_u=1.23 ∇_λ=.828	∇_u= ∇_λ=	∇_u=4.08 ∇_λ=1.26
CAMERA ON-TIME	∇_u=.00116 ∇_λ=.00007	∇_u= ∇_λ=	∇_u=.00113 ∇_λ=.00031	∇_u= ∇_λ=	∇_u=.00372 ∇_λ=.00045	∇_u= ∇_λ=	∇_u=.00117 ∇_λ=.00007	∇_u= ∇_λ=	∇_u=.00402 ∇_λ=.00036
MOON RADIUS	∇_u=.00004 ∇_λ=.00076	∇_u= ∇_λ=	∇_u=.00208 ∇_λ=.0163	∇_u= ∇_λ=	∇_u=.0430 ∇_λ=.00535	∇_u= ∇_λ=	∇_u=.00388 ∇_λ=.0245	∇_u= ∇_λ=	∇_u=.0451 ∇_λ=.00682

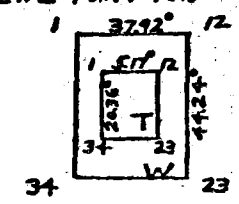
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION IV FRAME 125





S/C ALTITUDE = 2715 KM
TRUE ANOMALY = 311. °
INCLINATION ≈ 85. °
NOTE: APOLLO FRAME
2ND OF SERIES



TELEPHOTO LENS, T

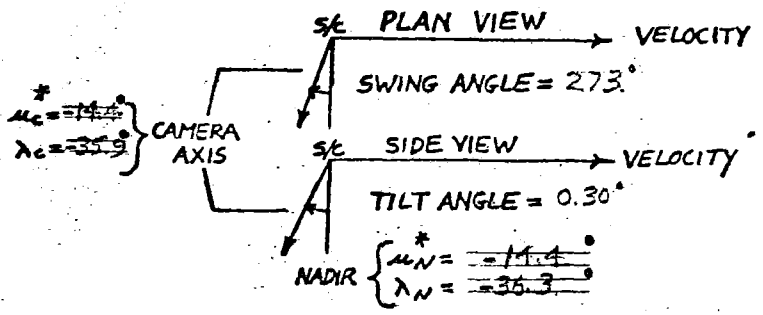
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .551° 16.7 KM; σ_λ = .240° 7.27 KM	σ_u = .640° 19.4 KM; σ_λ = .259° 7.85 KM	σ_u = .531° 16.1 KM; σ_λ = .241° 7.30 KM	σ_u = .603° 18.3 KM; σ_λ = .374° 11.3 KM	σ_u = .629° 19.0 KM; σ_λ = .350° 10.6 KM	σ_u = .663° 20.1 KM; σ_λ = .328° 9.93 KM	σ_u = .576° 17.5 KM; σ_λ = .244° 7.40 KM	σ_u = .680° 20.6 KM; σ_λ = .252° 7.64 KM	σ_u = .659° 19.9 KM; σ_λ = .252° 7.64 KM
NAVIGATION	σ_u = .00203; σ_λ = .00108	σ_u = .00222; σ_λ = .00101	σ_u = .00201; σ_λ = .00111	σ_u = .00222; σ_λ = .00145	σ_u = .00225; σ_λ = .00131	σ_u = .00227; σ_λ = .00115	σ_u = .00205; σ_λ = .00104	σ_u = .00227; σ_λ = .00108	σ_u = .00224; σ_λ = .00105
ATTITUDE	σ_u = .551; σ_λ = .240	σ_u = .640; σ_λ = .259	σ_u = .531; σ_λ = .240	σ_u = .603; σ_λ = .374	σ_u = .629; σ_λ = .350	σ_u = .663; σ_λ = .328	σ_u = .576; σ_λ = .244	σ_u = .680; σ_λ = .252	σ_u = .659; σ_λ = .252
CAMERA ON-TIME	σ_u = .00115; σ_λ = .00008	σ_u = .00126; σ_λ = .00009	σ_u = .00115; σ_λ = .00006	σ_u = .00128; σ_λ = .00003	σ_u = .00128; σ_λ = .00004	σ_u = .00129; σ_λ = .00014	σ_u = .00115; σ_λ = .00011	σ_u = .00125; σ_λ = .00006	σ_u = .00125; σ_λ = .00007
MOON RADIUS	σ_u = .00001; σ_λ = .00017	σ_u = .00687; σ_λ = .00119	σ_u = .00073; σ_λ = .00167	σ_u = .00638; σ_λ = .00327	σ_u = .00658; σ_λ = .00128	σ_u = .00679; σ_λ = .00113	σ_u = .00065; σ_λ = .00136	σ_u = .00654; σ_λ = .00206	σ_u = .00663; σ_λ = .00058

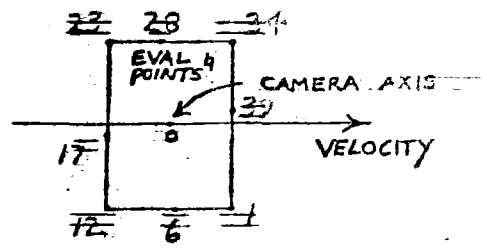
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .634° 19.2 KM; σ_λ = .251° 7.60 KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = .547° 16.6 KM; σ_λ = .546° 16.5 KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = 2.77° 83.9 KM; σ_λ = 3.76° 114 KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = .984° 29.8 KM; σ_λ = .523° 15.8 KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = 3.78° 111. KM; σ_λ = .711° 21.5 KM
NAVIGATION	σ_u = .00203; σ_λ = .00108	σ_u =; σ_λ =	σ_u = .00174; σ_λ = .00180	σ_u =; σ_λ =	σ_u = .00709; σ_λ = .0103	σ_u =; σ_λ =	σ_u = .00219; σ_λ = .00105	σ_u =; σ_λ =	σ_u = .00734; σ_λ = .00263
ATTITUDE	σ_u = .634; σ_λ = .251	σ_u =; σ_λ =	σ_u = .547; σ_λ = .546	σ_u =; σ_λ =	σ_u = 2.77; σ_λ = 3.76	σ_u =; σ_λ =	σ_u = .984; σ_λ = .523	σ_u =; σ_λ =	σ_u = 3.78; σ_λ = .711
CAMERA ON-TIME	σ_u = .00115; σ_λ = .00008	σ_u =; σ_λ =	σ_u = .00121; σ_λ = .00013	σ_u =; σ_λ =	σ_u = .00396; σ_λ = .00378	σ_u =; σ_λ =	σ_u = .00111; σ_λ = .00059	σ_u =; σ_λ =	σ_u = .00389; σ_λ = .00063
MOON RADIUS	σ_u = .00001; σ_λ = .00017	σ_u =; σ_λ =	σ_u = .00633; σ_λ = .0200	σ_u =; σ_λ =	σ_u = .0444; σ_λ = .0492	σ_u =; σ_λ =	σ_u = .00011; σ_λ = .0200	σ_u =; σ_λ =	σ_u = .0466; σ_λ = .0114

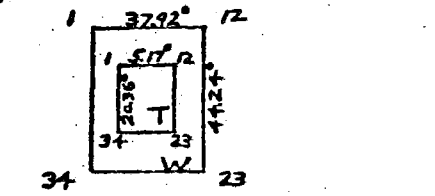
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION IV FRAME 137





S/C ALTITUDE = 276 KM
TRUE ANOMALY = 340 °
INCLINATION = 85 °
NOTE: APOLLO FRAME
2ND OF SERIES



TELEPHOTO LENS, T

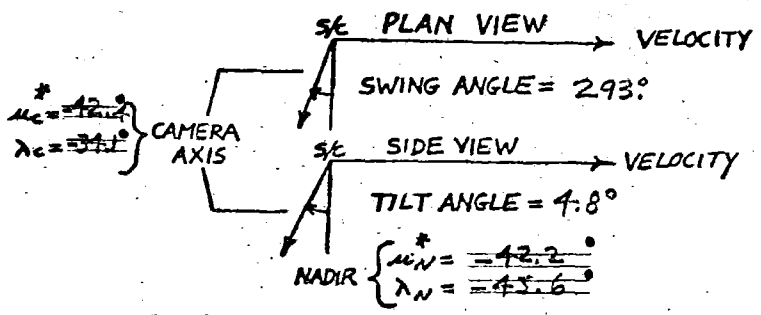
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.49022° 14.9 KM; σ_λ=.23919° 7.25 KM	σ_μ=.56520° 17.1 KM; σ_λ=.25628° 7.78 KM	σ_μ=.46587° 14.2 KM; σ_λ=.23871° 7.25 KM	σ_μ=.52503° 15.9 KM; σ_λ=.37475° 11.4 KM	σ_μ=.55867° 16.9 KM; σ_λ=.35111° 10.7 KM	σ_μ=.60125° 18.2 KM; σ_λ=.32912° 9.99 KM	σ_μ=.52424° 15.9 KM; σ_λ=.24345° 7.38 KM	σ_μ=.62079° 18.9 KM; σ_λ=.24577° 7.46 KM	σ_μ=.59394° 18.0 KM; σ_λ=.24758° 7.52 KM
NAVIGATION	σ_μ=.00306; σ_λ=.00103	σ_μ=.00337; σ_λ=.00095	σ_μ=.00304; σ_λ=.00107	σ_μ=.00334; σ_λ=.00150	σ_μ=.00337; σ_λ=.00130	σ_μ=.00339; σ_λ=.00106	σ_μ=.00308; σ_λ=.00098	σ_μ=.00340; σ_λ=.00106	σ_μ=.00338; σ_λ=.00101
ATTITUDE	σ_μ=.49320; σ_λ=.23919	σ_μ=.56515; σ_λ=.25628	σ_μ=.46586; σ_λ=.23870	σ_μ=.52498; σ_λ=.37473	σ_μ=.55862; σ_λ=.35110	σ_μ=.60120; σ_λ=.32912	σ_μ=.52423; σ_λ=.24344	σ_μ=.62070; σ_λ=.24576	σ_μ=.59339; σ_λ=.24758
CAMERA ON-TIME	σ_μ=.00115; σ_λ=.00008	σ_μ=.00126; σ_λ=.00010	σ_μ=.00115; σ_λ=.00006	σ_μ=.00128; σ_λ=.00003	σ_μ=.00128; σ_λ=.00005	σ_μ=.00129; σ_λ=.00015	σ_μ=.00115; σ_λ=.00011	σ_μ=.00124; σ_λ=.00007	σ_μ=.00125; σ_λ=.00008
MOON RADIUS	σ_μ=.00001; σ_λ=.00018	σ_μ=.00686; σ_λ=.00123	σ_μ=.00072; σ_λ=.00168	σ_μ=.00691; σ_λ=.00325	σ_μ=.00660; σ_λ=.00125	σ_μ=.00680; σ_λ=.00116	σ_μ=.00065; σ_λ=.00136	σ_μ=.00654; σ_λ=.00203	σ_μ=.00663; σ_λ=.00055

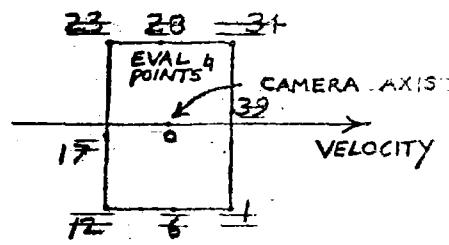
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.58533° 17.8 KM; σ_λ=.24959° 7.60 KM	σ_μ= ° KM; σ_λ= ° KM	σ_μ=.41335° 12.5 KM; σ_λ=.54736° 16.6 KM	σ_μ= ° KM; σ_λ= ° KM	σ_μ=.25755° 78.2 KM; σ_λ=.37182° 113 KM	σ_μ= ° KM; σ_λ= ° KM	σ_μ=.97014° 29.4 KM; σ_λ=.52214° 15.8 KM	σ_μ= ° KM; σ_λ= ° KM	σ_μ=.34640° 105 KM; σ_λ=.48892° 14.8 KM
NAVIGATION	σ_μ=.00306; σ_λ=.00103	σ_μ= ; σ_λ=	σ_μ=.00283; σ_λ=.00167	σ_μ= ; σ_λ=	σ_μ=.01037; σ_λ=.01325	σ_μ= ; σ_λ=	σ_μ=.00319; σ_λ=.00067	σ_μ= ; σ_λ=	σ_μ=.01112; σ_λ=.00324
ATTITUDE	σ_μ=.58532; σ_λ=.24959	σ_μ= ; σ_λ=	σ_μ=.41329; σ_λ=.54699	σ_μ= ; σ_λ=	σ_μ=.25751; σ_λ=.37179	σ_μ= ; σ_λ=	σ_μ=.97014; σ_λ=.52176	σ_μ= ; σ_λ=	σ_μ=.34637; σ_λ=.48879
CAMERA ON-TIME	σ_μ=.00115; σ_λ=.00008	σ_μ= ; σ_λ=	σ_μ=.00121; σ_λ=.00013	σ_μ= ; σ_λ=	σ_μ=.00401; σ_λ=.00381	σ_μ= ; σ_λ=	σ_μ=.00111; σ_λ=.00059	σ_μ= ; σ_λ=	σ_μ=.00387; σ_λ=.00059
MOON RADIUS	σ_μ=.00001; σ_λ=.00018	σ_μ= ; σ_λ=	σ_μ=.00628; σ_λ=.02005	σ_μ= ; σ_λ=	σ_μ=.04503; σ_λ=.04956	σ_μ= ; σ_λ=	σ_μ=.00065; σ_λ=.01998	σ_μ= ; σ_λ=	σ_μ=.04652; σ_λ=.01098

* μ = LATITUDE λ = LONGITUDE

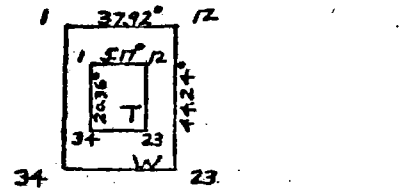
ERROR ANALYSIS RESULTS MISSION IV FRAME 142(B)





S/C ALTITUDE = 3005 KM
TRUE ANOMALY = 312.°
INCLINATION ≈ 85.°
NOTE: 2nd OF SERIES

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

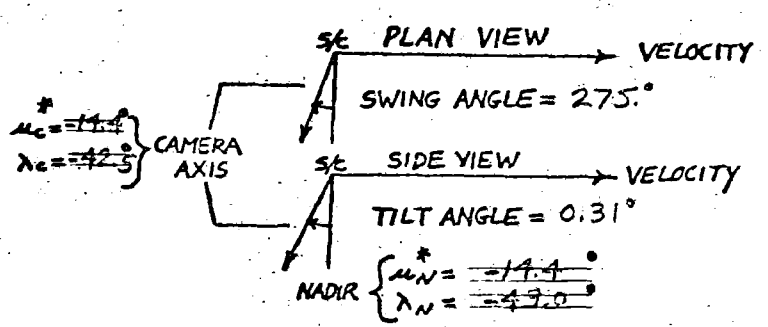
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$=.58460° 17.8 KM; $\nabla\lambda$=.42279° 12.8 KM	$\nabla\mu$=.74485° 22.6 KM; $\nabla\lambda$=.35229° 10.7 KM	$\nabla\mu$=.55625° 16.9 KM; $\nabla\lambda$=.41052° 12.4 KM	$\nabla\mu$=.41052° 12.4 KM; $\nabla\lambda$=1.2443° 37.6 KM	$\nabla\mu$=.52330° 15.9 KM; $\nabla\lambda$=1.2451° 38.0 KM	$\nabla\mu$=.63660° 19.3 KM; $\nabla\lambda$=.12175° 37.0 KM	$\nabla\mu$=.62421° 18.9 KM; $\nabla\lambda$=.43507° 13.2 KM	$\nabla\mu$=.76503° 23.2 KM; $\nabla\lambda$=.34379° 10.4 KM	$\nabla\mu$=.75068° 22.8 KM; $\nabla\lambda$=.34359° 10.4 KM
NAVIGATION	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0
ATTITUDE	$\nabla\mu$=.58460; $\nabla\lambda$=.42277	$\nabla\mu$=.74446; $\nabla\lambda$=.35228	$\nabla\mu$=.55626; $\nabla\lambda$=.41048	$\nabla\mu$=.43789; $\nabla\lambda$=1.2441	$\nabla\mu$=.52328; $\nabla\lambda$=1.2450	$\nabla\mu$=.63656; $\nabla\lambda$=1.2174	$\nabla\mu$=.62421; $\nabla\lambda$=.43506	$\nabla\mu$=.76501; $\nabla\lambda$=.34379	$\nabla\mu$=.75065; $\nabla\lambda$=.34359
CAMERA ON-TIME	$\nabla\mu$=.00108; $\nabla\lambda$=.00007	$\nabla\mu$=.00119; $\nabla\lambda$=.00006	$\nabla\mu$=.00108; $\nabla\lambda$=.00012	$\nabla\mu$=.00106; $\nabla\lambda$=.00116	$\nabla\mu$=.00114; $\nabla\lambda$=.00102	$\nabla\mu$=.00123; $\nabla\lambda$=.00077	$\nabla\mu$=.00109; $\nabla\lambda$=.00001	$\nabla\mu$=.00113; $\nabla\lambda$=.00014	$\nabla\mu$=.00115; $\nabla\lambda$=.00010
MOON RADIUS	$\nabla\mu$=.00010; $\nabla\lambda$=.00420	$\nabla\mu$=.00743; $\nabla\lambda$=.00261	$\nabla\mu$=.00161; $\nabla\lambda$=.00567	$\nabla\mu$=.00284; $\nabla\lambda$=.01969	$\nabla\mu$=.00477; $\nabla\lambda$=.01710	$\nabla\mu$=.00677; $\nabla\lambda$=.01326	$\nabla\mu$=.00123; $\nabla\lambda$=.00253	$\nabla\mu$=.00572; $\nabla\lambda$=.00048	$\nabla\mu$=.00635; $\nabla\lambda$=.00092

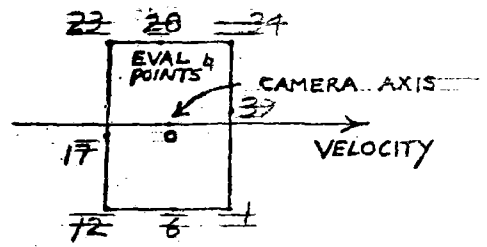
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$=.68935° 20.9 KM; $\nabla\lambda$=.44560° 13.8 KM	$\nabla\mu$= ° KM; $\nabla\lambda$= ° KM	$\nabla\mu$= ° KM; $\nabla\lambda$= ° KM	$\nabla\mu$= ° KM; $\nabla\lambda$= ° KM	$\nabla\mu$= ° KM; $\nabla\lambda$= ° KM	$\nabla\mu$= ° KM; $\nabla\lambda$= ° KM	$\nabla\mu$=1.0793° 32.6 KM; $\nabla\lambda$=1.0780° 32.6 KM	$\nabla\mu$= ° KM; $\nabla\lambda$= ° KM	$\nabla\mu$=3.53158° 107 KM; $\nabla\lambda$=.43855° 13.3 KM
NAVIGATION	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=0; $\nabla\lambda$=0
ATTITUDE	$\nabla\mu$=.68935; $\nabla\lambda$=.44558	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=1.0793; $\nabla\lambda$=1.0778	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=3.53133; $\nabla\lambda$=.43852
CAMERA ON-TIME	$\nabla\mu$=.00108; $\nabla\lambda$=.00007	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=.00086; $\nabla\lambda$=.00155	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=.00290; $\nabla\lambda$=.00009
MOON RADIUS	$\nabla\mu$=.00010; $\nabla\lambda$=.00420	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=.00021; $\nabla\lambda$=.02087	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=.03842; $\nabla\lambda$=.00528

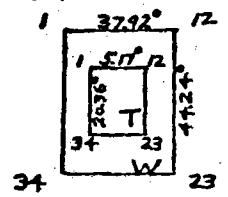
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION IV FRAME 143





S/C ALTITUDE = ~~2717~~ KM
TRUE ANOMALY = ~~340.~~ °
INCLINATION ≈ ~~85.~~ °
NOTE: ~~APOLLO FIGURE~~
3RD OF SERIES



TELEPHOTO LENS, T

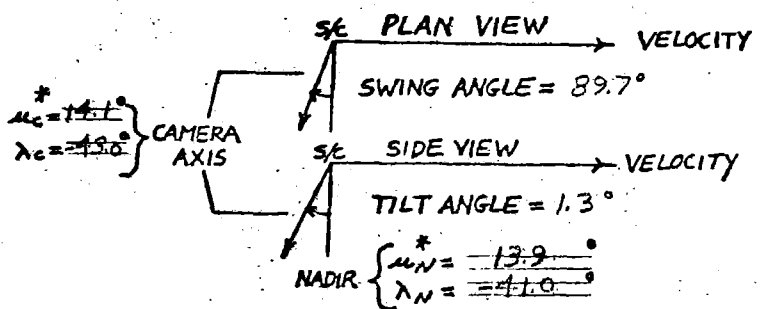
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.62072 σ_λ=.31558 19.8 KM 9.60 KM	σ_u=.71053 σ_λ=.34084 21.5 KM 10.4 KM	σ_u=.58620 σ_λ=.31525 17.8 KM 9.95 KM	σ_u=.66161 σ_λ=.48673 20.1 KM 14.8 KM	σ_u=.70389 σ_λ=.45773 21.4 KM 13.9 KM	σ_u=.75766 σ_λ=.43151 22.9 KM 13.1 KM	σ_u=.66005 σ_λ=.32109 20.0 KM 9.73 KM	σ_u=.78086 σ_λ=.32758 23.7 KM 9.95 KM	σ_u=.74624 σ_λ=.32977 22.6 KM 10.0 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.62072 σ_λ=.31556	σ_u=.71053 σ_λ=.34083	σ_u=.58620 σ_λ=.31524	σ_u=.66157 σ_λ=.48672	σ_u=.70386 σ_λ=.45773	σ_u=.75763 σ_λ=.43151	σ_u=.66004 σ_λ=.32109	σ_u=.78083 σ_λ=.32758	σ_u=.74621 σ_λ=.32977
CAMERA ON-TIME	σ_u=.00115 σ_λ=.00009	σ_u=.00126 σ_λ=.00010	σ_u=.00115 σ_λ=.00007	σ_u=.00128 σ_λ=.00003	σ_u=.00128 σ_λ=.00005	σ_u=.00129 σ_λ=.00015	σ_u=.00115 σ_λ=.00012	σ_u=.00124 σ_λ=.00007	σ_u=.00125 σ_λ=.00008
MOON RADIUS	σ_u=0 σ_λ=.00019	σ_u=.00685 σ_λ=.00125	σ_u=.00071 σ_λ=.00169	σ_u=.00643 σ_λ=.00124	σ_u=.00661 σ_λ=.00124	σ_u=.00681 σ_λ=.00118	σ_u=.00066 σ_λ=.00136	σ_u=.00654 σ_λ=.00201	σ_u=.00662 σ_λ=.00053

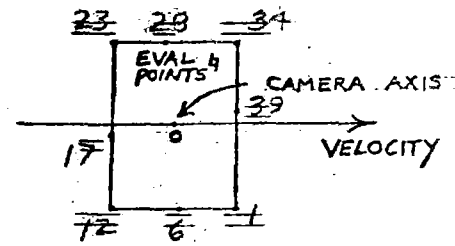
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.73411 σ_λ=.32712 22.3 KM 9.90 KM	σ_u= ° σ_λ= ° KM KM	σ_u=.52611 σ_λ=.72192 16.0 KM 21.9 KM	σ_u= ° σ_λ= ° KM KM	σ_u=3.2780 σ_λ=4.7725 995 KM 144 KM	σ_u= ° σ_λ= ° KM KM	σ_u=1.2255 σ_λ=.68523 37.2 KM 208 KM	σ_u= ° σ_λ= ° KM KM	σ_u=4.3107 σ_λ=.63950 131 KM 194 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u= σ_λ=	σ_u=0 σ_λ=0	σ_u= σ_λ=	σ_u=0 σ_λ=0	σ_u= σ_λ=	σ_u=0 σ_λ=0	σ_u= σ_λ=	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.73411 σ_λ=.32712	ND	σ_u=.52607 σ_λ=.72164	ND	σ_u=3.2776 σ_λ=4.7722	ND	σ_u=1.2253 σ_λ=.68494	ND	σ_u=4.3101 σ_λ=.63941
CAMERA ON-TIME	σ_u=.00115 σ_λ=.00009	σ_u= σ_λ=	σ_u=.00121 σ_λ=.00013	σ_u= σ_λ=	σ_u=.00407 σ_λ=.00389	σ_u= σ_λ=	σ_u=.00111 σ_λ=.00060	σ_u= σ_λ=	σ_u=.00385 σ_λ=.00057
MOON RADIUS	σ_u=0 σ_λ=.00019	σ_u= σ_λ=	σ_u=.00625 σ_λ=.02101	σ_u= σ_λ=	σ_u=.04570 σ_λ=.05047	σ_u= σ_λ=	σ_u=.00002 σ_λ=.01998	σ_u= σ_λ=	σ_u=.04629 σ_λ=.01071

* μ = LATITUDE λ = LONGITUDE

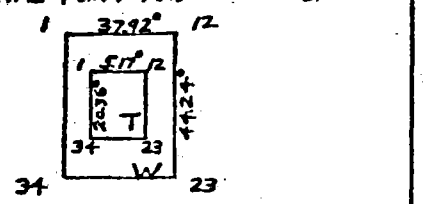
ERROR ANALYSIS RESULTS MISSION IV FRAME 144





S/C ALTITUDE = 2667 KM
TRUE ANOMALY = 8.3 °
INCLINATION ≈ 85 °
NOTE: APOLLO EX ME
4TH OF SERIES

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

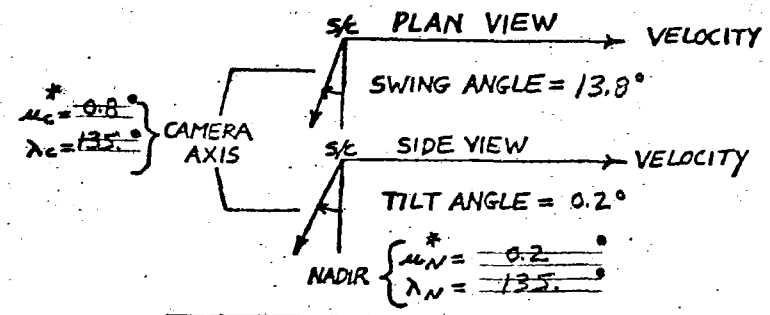
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u=.70690° 21.4 KM; $\nabla\lambda$=.35209° 10.7 KM	∇u=.75297° 22.8 KM; $\nabla\lambda$=.52688° 15.9 KM	∇u=.66282° 20.1 KM; $\nabla\lambda$=.35999° 10.9 KM	∇u=.79520° 24.1 KM; $\nabla\lambda$=.36256° 11.0 KM	∇u=.83115° 25.2 KM; $\nabla\lambda$=.35760° 10.4 KM	∇u=.88061° 26.7 KM; $\nabla\lambda$=.36087° 10.9 KM	∇u=.75447° 22.8 KM; $\nabla\lambda$=.35297° 10.7 KM	∇u=.86603° 26.2 KM; $\nabla\lambda$=.47788° 14.5 KM	∇u=.81271° 24.7 KM; $\nabla\lambda$=.49619° 15.0 KM
NAVIGATION	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0
ATTITUDE	∇u=.70690 $\nabla\lambda$=.35209	∇u=.75294 $\nabla\lambda$=.52688	∇u=.66282 $\nabla\lambda$=.35999	∇u=.79519 $\nabla\lambda$=.36256	∇u=.83113 $\nabla\lambda$=.35760	∇u=.88059 $\nabla\lambda$=.36085	∇u=.75446 $\nabla\lambda$=.35296	∇u=.86600 $\nabla\lambda$=.47788	∇u=.81268 $\nabla\lambda$=.49620
CAMERA ON-TIME	∇u=.00116 $\nabla\lambda$=.00004	∇u=.00128 $\nabla\lambda$=.00018	∇u=.00116 $\nabla\lambda$=.00011	∇u=.00127 $\nabla\lambda$=.00009	∇u=.00127 $\nabla\lambda$=.00010	∇u=.00127 $\nabla\lambda$=.00012	∇u=.00116 $\nabla\lambda$=.00006	∇u=.00130 $\nabla\lambda$=.00001	∇u=.00129 $\nabla\lambda$=.00009
MOON RADIUS	∇u=.00007 $\nabla\lambda$=.00075	∇u=.00639 $\nabla\lambda$=.00199	∇u=.00044 $\nabla\lambda$=.00085	∇u=.00663 $\nabla\lambda$=.00013	∇u=.00648 $\nabla\lambda$=.00132	∇u=.00642 $\nabla\lambda$=.00311	∇u=.00036 $\nabla\lambda$=.00237	∇u=.00684 $\nabla\lambda$=.00233	∇u=.00664 $\nabla\lambda$=.00032

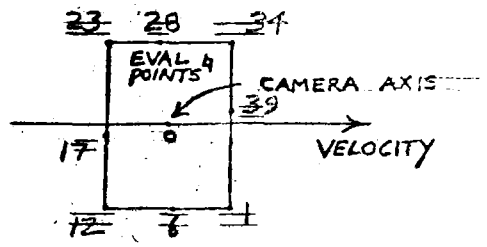
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u=.83633° 25.4 KM; $\nabla\lambda$=.36621° 11.1 KM	∇u= ° KM; $\nabla\lambda$= ° KM	∇u=.50585° 15.3 KM; $\nabla\lambda$=.69253° 21.0 KM	∇u= ° KM; $\nabla\lambda$= ° KM	∇u=.34548° 10.5 KM; $\nabla\lambda$=.61488° 18.6 KM	∇u= ° KM; $\nabla\lambda$= ° KM	∇u=1.4516° 44.0 KM; $\nabla\lambda$=.87091° 26.4 KM	∇u= ° KM; $\nabla\lambda$= ° KM	∇u=4.4379° 134 KM; $\nabla\lambda$=1.7135° 51.8 KM
NAVIGATION	∇u=0 $\nabla\lambda$=0	∇u= $\nabla\lambda$=	∇u=0 $\nabla\lambda$=0	∇u= $\nabla\lambda$=	∇u=0 $\nabla\lambda$=0	∇u= $\nabla\lambda$=	∇u=0 $\nabla\lambda$=0	∇u= $\nabla\lambda$=0	∇u=0 $\nabla\lambda$=0
ATTITUDE	∇u=.83632 $\nabla\lambda$=.36620	∇u= $\nabla\lambda$=	∇u=.50584 $\nabla\lambda$=.69235	∇u= $\nabla\lambda$=	∇u=.34546 $\nabla\lambda$=.61486	∇u= $\nabla\lambda$=	∇u=1.4516 $\nabla\lambda$=.87007	∇u= $\nabla\lambda$=	∇u=4.4377 $\nabla\lambda$=1.7135
CAMERA ON-TIME	∇u=.00116 $\nabla\lambda$=.00008	∇u= $\nabla\lambda$=	∇u=.00113 $\nabla\lambda$=.00032	∇u= $\nabla\lambda$=	∇u=.00355 $\nabla\lambda$=.00045	∇u= $\nabla\lambda$=	∇u=.00117 $\nabla\lambda$=.00006	∇u= $\nabla\lambda$=	∇u=.00397 $\nabla\lambda$=.00018
MOON RADIUS	∇u=.00007 $\nabla\lambda$=.00075	∇u= $\nabla\lambda$=	∇u=.00211 $\nabla\lambda$=.01620	∇u= $\nabla\lambda$=	∇u=.04073 $\nabla\lambda$=.00533	∇u= $\nabla\lambda$=	∇u=.00365 $\nabla\lambda$=.02423	∇u= $\nabla\lambda$=	∇u=.04454 $\nabla\lambda$=.00492

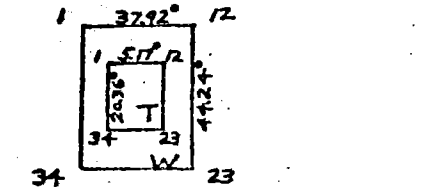
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION IV FRAME 146





S/C ALTITUDE = 6146. KM
TRUE ANOMALY = 174. °
INCLINATION ≈ 65. °
NOTE: P(162°) Y(-7.5°, PM 0°)
1 ST OF SERIES



TELEPHOTO LENS, T

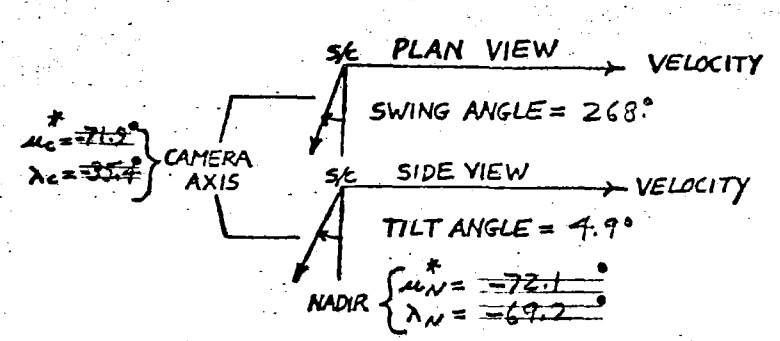
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .881° 26.7 KM; σ_λ = .503° 15.2 KM	σ_u = 1.62° 49.1 KM; σ_λ = 1.40° 42.5 KM	σ_u = .959° 29.0 KM; σ_λ = .564° 17.1 KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = .830° 25.2 KM; σ_λ = .465° 14.1 KM	σ_u = 1.19° 36.1 KM; σ_λ = 1.61° 48.8 KM	σ_u = 1.34° 40.6 KM; σ_λ = 1.47° 44.5 KM
NAVIGATION	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0	σ_u = 0; σ_λ = 0
ATTITUDE	σ_u = .881; σ_λ = .503	σ_u = 1.62; σ_λ = 1.40	σ_u = .959; σ_λ = .564	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u = .830; σ_λ = .465	σ_u = 1.19; σ_λ = 1.61	σ_u = 1.34; σ_λ = 1.47
CAMERA ON-TIME	σ_u = .00065; σ_λ = .00005	σ_u = .00110; σ_λ = .00018	σ_u = .00065; σ_λ = .00003	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u = .00066; σ_λ = .00003	σ_u = .00093; σ_λ = .00052	σ_u = .00098; σ_λ = .00038
MOON RADIUS	σ_u = .00017; σ_λ = .00002	σ_u = .0181; σ_λ = .00326	σ_u = .00165; σ_λ = .00230	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u = .00201; σ_λ = .00228	σ_u = .0134; σ_λ = .0153	σ_u = .0149; σ_λ = .00984

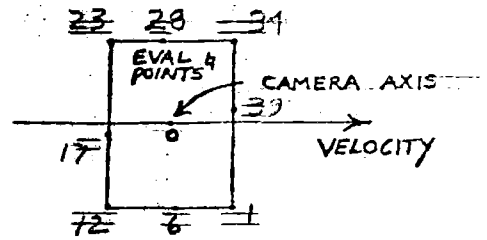
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .972° 29.5 KM; σ_λ = .547° 16.6 KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM	σ_u = ND° KM; σ_λ = ND° KM
NAVIGATION	σ_u = 0; σ_λ = 0	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =
ATTITUDE	σ_u = .972; σ_λ = .547	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =
CAMERA ON-TIME	σ_u = .00065; σ_λ = .00005	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =
MOON RADIUS	σ_u = .00017; σ_λ = .00002	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =	σ_u =; σ_λ =

* μ = LATITUDE λ = LONGITUDE

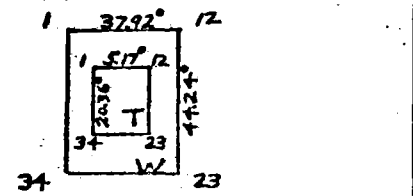
ERROR ANALYSIS RESULTS MISSION IV FRAME 154





S/C ALTITUDE = 3612. KM
TRUE ANOMALY = 2.81. °
INCLINATION ≈ 85. °
NOTE: 1ST OF SERIES

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

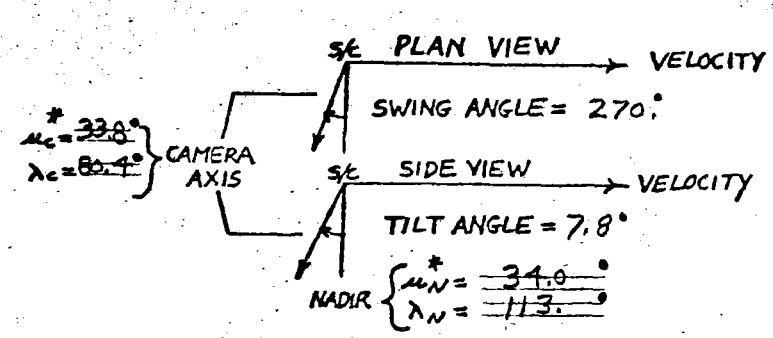
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.149° 4.52 KM; σ_λ=.870° 26.3 KM	σ_u=.227° 6.88 KM; σ_λ=.499° 15.1 KM	σ_u=.169° 5.12 KM; σ_λ=.710° 21.5 KM	σ_u=.460° 13.9 KM; σ_λ=.824° 25.0 KM	σ_u=.412° 12.5 KM; σ_λ=1.51° 45.7 KM	σ_u=.212° 6.43 KM; σ_λ=4.71° 143. KM	σ_u=.189° 5.73 KM; σ_λ=.977° 29.6 KM	σ_u=.239° 7.25 KM; σ_λ=.494° 15.0 KM	σ_u=.221° 6.70 KM; σ_λ=.495° 15.0 KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0	σ_u=0 σ_λ=0
ATTITUDE	σ_u=.149 σ_λ=.870	σ_u=.227 σ_λ=.499	σ_u=.169 σ_λ=.710	σ_u=.460 σ_λ=.824	σ_u=.412 σ_λ=1.51	σ_u=.211 σ_λ=4.71	σ_u=.189 σ_λ=.977	σ_u=.238 σ_λ=.494	σ_u=.221 σ_λ=.495
CAMERA ON-TIME	σ_u=.00091 σ_λ=.00096	σ_u=.00108 σ_λ=.00031	σ_u=.00082 σ_λ=.00132	σ_u=.00077 σ_λ=.00420	σ_u=.00092 σ_λ=.00528	σ_u=.00111 σ_λ=.00178	σ_u=.00096 σ_λ=.00001	σ_u=.00108 σ_λ=.00002	σ_u=.00108 σ_λ=.00014
MOON RADIUS	σ_u=.00104 σ_λ=.0110	σ_u=.0113 σ_λ=.00644	σ_u=.00340 σ_λ=.0125	σ_u=.0104 σ_λ=.0220	σ_u=.00917 σ_λ=.0235	σ_u=.00317 σ_λ=.0277	σ_u=.00059 σ_λ=.00598	σ_u=.00872 σ_λ=.00333	σ_u=.00957 σ_λ=.00476

WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.154° 4.67 KM; σ_λ=.906° 27.4 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=.551° 16.7 KM; σ_λ=.839° 25.4 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM
NAVIGATION	σ_u=0 σ_λ=0	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=0 σ_λ=0	σ_u= σ_λ=	σ_u= σ_λ=
ATTITUDE	σ_u=.154 σ_λ=.905	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.551 σ_λ=.839	σ_u= σ_λ=	σ_u= σ_λ=
CAMERA ON-TIME	σ_u=.00091 σ_λ=.00096	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.00025 σ_λ=.00143	σ_u= σ_λ=	σ_u= σ_λ=
MOON RADIUS	σ_u=.00104 σ_λ=.0110	σ_u= ↓ σ_λ= ↓	σ_u= ↓ σ_λ= ↓	σ_u= ↓ σ_λ= ↓	σ_u= ↓ σ_λ= ↓	σ_u= ↓ σ_λ= ↓	σ_u=.0133 σ_λ=.0104	σ_u= ↓ σ_λ= ↓	σ_u= ↓ σ_λ= ↓

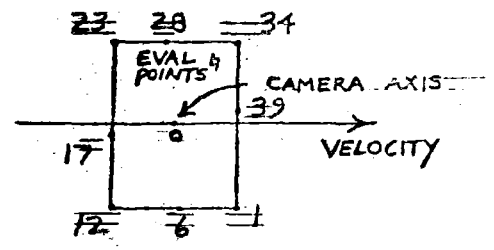
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION IV FRAME 165



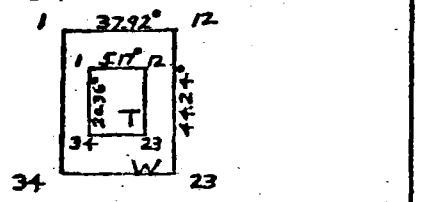
μ_c = ~~33.8~~ °
λ_c = ~~80.4~~ °

μ_N = ~~34.0~~ °
λ_N = ~~113.~~ °



S/C ALTITUDE = ~~5484~~. KM
TRUE ANOMALY = ~~140.~~ °
INCLINATION = ~~85.~~ °
NOTE: ~~R(-15°) P(32°) Y(0°)~~
CELESTIAL ALIGNMENT

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

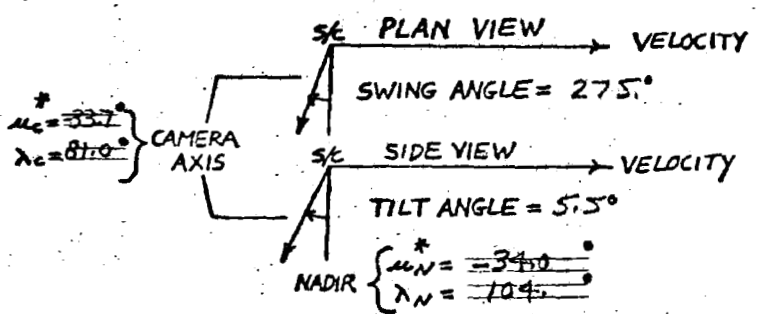
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.725° 22.0 KM; σ_λ=.593° 17.8 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=.745° 22.6 KM; σ_λ=.709° 21.5 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=.745° 22.6 KM; σ_λ=.535° 16.2 KM	σ_u=1.39° 42.1 KM; σ_λ=.711° 21.6 KM	σ_u=1.81° 54.9 KM; σ_λ=1.13° 34.3 KM
NAVIGATION	σ_u=.00598; σ_λ=.00416	σ_u=; σ_λ=	σ_u=.00612; σ_λ=.00358	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=.00594; σ_λ=.00350	σ_u=.00980; σ_λ=.00234	σ_u=.0123; σ_λ=.00529
ATTITUDE	σ_u=.725; σ_λ=.589	σ_u=; σ_λ=	σ_u=.745; σ_λ=.703	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=.746; σ_λ=.535	σ_u=1.39; σ_λ=.711	σ_u=1.81; σ_λ=1.13
CAMERA ON-TIME	σ_u=.00065; σ_λ=.00036	σ_u=; σ_λ=	σ_u=.00061; σ_λ=.00241	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=.00088; σ_λ=.00029	σ_u=.00108; σ_λ=.00006	σ_u=.00125; σ_λ=.00024
MOON RADIUS	σ_u=.00147; σ_λ=.0107	σ_u=; σ_λ=	σ_u=.00519; σ_λ=.0160	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=.00064; σ_λ=.00692	σ_u=.0164; σ_λ=.00913	σ_u=.0229; σ_λ=.0170

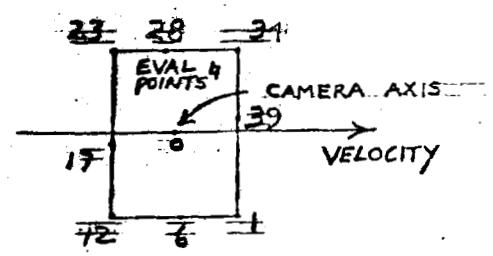
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.795° 24.1 KM; σ_λ=.608° 13.4 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=.996° 30.2 KM; σ_λ=1.05° 31.9 KM	σ_u=ND° KM; σ_λ=ND° KM	σ_u=ND° KM; σ_λ=ND° KM
NAVIGATION	σ_u=.00596; σ_λ=.00045	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=.00419; σ_λ=.00509	σ_u=; σ_λ=	σ_u=; σ_λ=
ATTITUDE	σ_u=.795; σ_λ=.608	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=.996; σ_λ=1.05	σ_u=; σ_λ=	σ_u=; σ_λ=
CAMERA ON-TIME	σ_u=.00065; σ_λ=.00036	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=.00071; σ_λ=.00017	σ_u=; σ_λ=	σ_u=; σ_λ=
MOON RADIUS	σ_u=.00147; σ_λ=.0107	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=; σ_λ=	σ_u=.00738; σ_λ=.0184	σ_u=; σ_λ=	σ_u=; σ_λ=

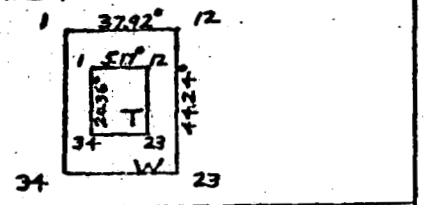
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION IV FRAME 178





S/C ALTITUDE = 5794. KM
TRUE ANOMALY = 209. °
INCLINATION ≈ 115. °
NOTE: R(133°) P(+2°) Y(0°)
CELESTIAL ALIGNMENT



TELEPHOTO LENS, T

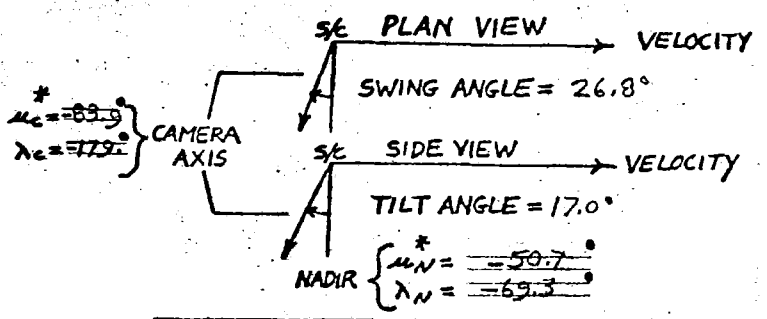
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.67890° 20.6KM σ_λ=.53558° 16.3 KM	σ_u= ° KM σ_λ= ° KM	σ_u=.64681° 19.6 KM σ_λ=.67219° 20.4 KM	σ_u= ° KM σ_λ= ° KM	σ_u= ° KM σ_λ= ° KM	σ_u= ° KM σ_λ= ° KM	σ_u=.70899° 21.5 KM σ_λ=.47821° 14.5 KM	σ_u=1.1963° 36.3 KM σ_λ=1.9045° 52.7 KM	σ_u= ° KM σ_λ= ° KM
NAVIGATION	σ_u=.00408 σ_λ=.00335	σ_u= σ_λ=	σ_u=.00371 σ_λ=.00675	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.00401 σ_λ=.00111	σ_u=.01135 σ_λ=.15352	σ_u= σ_λ=
ATTITUDE	σ_u=.67888 σ_λ=.53550	σ_u= ND σ_λ=	σ_u=.64680 σ_λ=.67204	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.70897 σ_λ=.47820	σ_u=1.1961 σ_λ=1.8983	σ_u= ND σ_λ=
CAMERA ON-TIME	σ_u=.00068 σ_λ=.00009	σ_u= σ_λ=	σ_u=.00658 σ_λ=.00224	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.00686 σ_λ=0	σ_u=.00977 σ_λ=.00049	σ_u= σ_λ=
MOON RADIUS	σ_u=.00077 σ_λ=.00719	σ_u= σ_λ=	σ_u=.00127 σ_λ=.01236	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u=.00124 σ_λ=.00359	σ_u=.01465 σ_λ=.01438	σ_u= σ_λ=

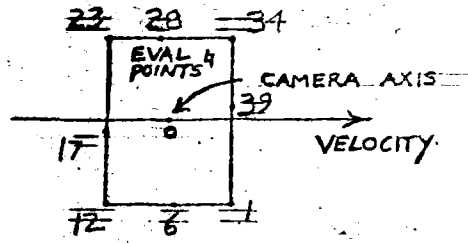
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.75384° 23.8 KM σ_λ=.55125° 16.3 KM	σ_u= ° KM σ_λ= ° KM	σ_u= ° KM σ_λ= ° KM	σ_u= ° KM σ_λ= ° KM	σ_u= ° KM σ_λ= ° KM	σ_u= ° KM σ_λ= ° KM	σ_u= ° KM σ_λ= ° KM	σ_u= ° KM σ_λ= ° KM	σ_u= ° KM σ_λ= ° KM
NAVIGATION	σ_u=.00408 σ_λ=.00335	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=
ATTITUDE	σ_u=.73383 σ_λ=.55120	σ_u= σ_λ= ND	σ_u= σ_λ=	σ_u= σ_λ= ND	σ_u= σ_λ=	σ_u= σ_λ= ND	σ_u= σ_λ=	σ_u= σ_λ= ND	σ_u= σ_λ=
CAMERA ON-TIME	σ_u=.00678 σ_λ=.00009	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=
MOON RADIUS	σ_u=.00077 σ_λ=.00719	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=	σ_u= σ_λ=

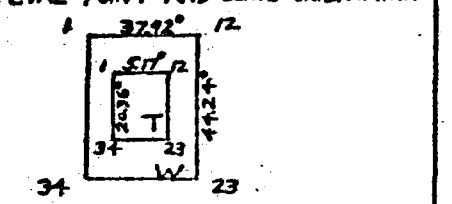
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 21





S/C ALTITUDE = 3343. KM
TRUE ANOMALY = 230. °
INCLINATION ≈ 85. °
NOTE: R(-31°) P(12.5°) Y(0°)



TELEPHOTO LENS, T

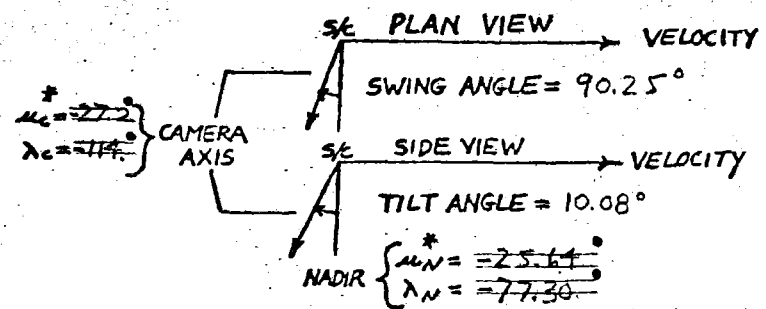
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .55216° (16.7 KM) $\nabla\lambda$ = 2.6496° (80.0 KM)	∇u = .11805° (3.57 KM) $\nabla\lambda$ = .92631° (28.1 KM)	∇u = .25701° (7.60 KM) $\nabla\lambda$ = .50019° (15.2 KM)	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = .99396° (30.1 KM) $\nabla\lambda$ = .83045° (25.2 KM)	∇u = .13000° (3.95 KM) $\nabla\lambda$ = 1.0787° (32.6 KM)	∇u = .09920° (3.00 KM) $\nabla\lambda$ = 1.0138° (30.7 KM)
NAVIGATION	∇u = .00368 $\nabla\lambda$ = .14854	∇u = .00989 $\nabla\lambda$ = .00242	∇u = .01362 $\nabla\lambda$ = .00835	∇u = ND $\nabla\lambda$ = ND	∇u = ND $\nabla\lambda$ = ND	∇u = ND $\nabla\lambda$ = ND	∇u = .02082 $\nabla\lambda$ = .05949	∇u = .00952 $\nabla\lambda$ = .00647	∇u = .00939 $\nabla\lambda$ = .00247
ATTITUDE	∇u = .55208 $\nabla\lambda$ = 2.6387	∇u = .11757 $\nabla\lambda$ = .92628	∇u = .25620 $\nabla\lambda$ = .50018	∇u = ND $\nabla\lambda$ = ND	∇u = ND $\nabla\lambda$ = ND	∇u = ND $\nabla\lambda$ = ND	∇u = .99313 $\nabla\lambda$ = .82505	∇u = .12969 $\nabla\lambda$ = 1.0785	∇u = .09865 $\nabla\lambda$ = 1.0137
CAMERA ON-TIME	∇u = .00024 $\nabla\lambda$ = .00932	∇u = .00072 $\nabla\lambda$ = .00005	∇u = .00089 $\nabla\lambda$ = .00047	∇u = ND $\nabla\lambda$ = ND	∇u = ND $\nabla\lambda$ = ND	∇u = ND $\nabla\lambda$ = ND	∇u = .00120 $\nabla\lambda$ = .00351	∇u = .00067 $\nabla\lambda$ = .00056	∇u = .00071 $\nabla\lambda$ = .00033
MOON RADIUS	∇u = .00874 $\nabla\lambda$ = .18602	∇u = .00395 $\nabla\lambda$ = .00701	∇u = .01514 $\nabla\lambda$ = .03232	∇u = ND $\nabla\lambda$ = ND	∇u = ND $\nabla\lambda$ = ND	∇u = ND $\nabla\lambda$ = ND	∇u = .03497 $\nabla\lambda$ = .07337	∇u = .00183 $\nabla\lambda$ = .01927	∇u = .00326 $\nabla\lambda$ = .01362

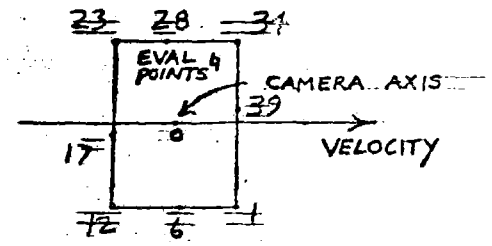
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .55982° (17.0 KM) $\nabla\lambda$ = 2.6460° (80.3 KM)	∇u = .33810° (10.2 KM) $\nabla\lambda$ = .60423° (18.4 KM)	∇u = .63359° (19.2 KM) $\nabla\lambda$ = 1.0577° (31.9 KM)	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = .13821° (5.55 KM) $\nabla\lambda$ = .69387° (21.1 KM)
NAVIGATION	∇u = .60368 $\nabla\lambda$ = .14854	∇u = .00912 $\nabla\lambda$ = .00555	∇u = .00236 $\nabla\lambda$ = .02567	∇u = ND $\nabla\lambda$ = ND	∇u = ND $\nabla\lambda$ = ND	∇u = ND $\nabla\lambda$ = ND	∇u = ND $\nabla\lambda$ = ND	∇u = ND $\nabla\lambda$ = ND	∇u = .01038 $\nabla\lambda$ = .00099
ATTITUDE	∇u = .55974 $\nabla\lambda$ = 2.6352	∇u = .33785 $\nabla\lambda$ = .60418	∇u = .63350 $\nabla\lambda$ = 1.0569	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = .13768 $\nabla\lambda$ = .69381
CAMERA ON-TIME	∇u = .00024 $\nabla\lambda$ = .00932	∇u = .00094 $\nabla\lambda$ = .00016	∇u = .00026 $\nabla\lambda$ = .00123	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = .00087 $\nabla\lambda$ = .00001
MOON RADIUS	∇u = .00874 $\nabla\lambda$ = .18602	∇u = .00899 $\nabla\lambda$ = .00544	∇u = .01031 $\nabla\lambda$ = .03203	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = .00607 $\nabla\lambda$ = .00901

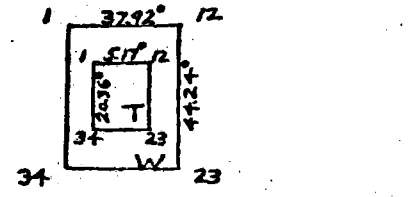
* u = LATITUDE, λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 22





S/C ALTITUDE = 5107. KM
TRUE ANOMALY = 204. °
INCLINATION ≈ 85. °
NOTE: R(=20°) P(=14.4°) Y(=0°)



TELEPHOTO LENS, T

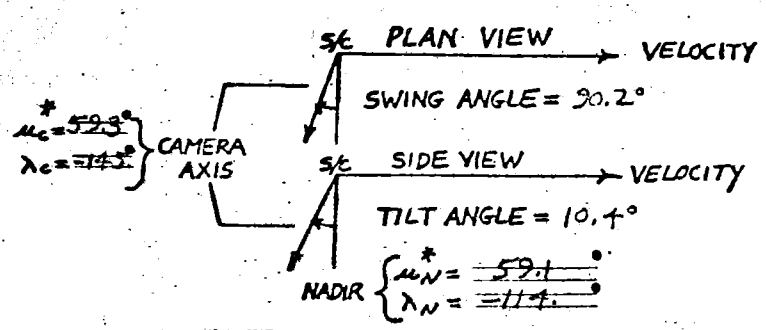
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u=.15102° 9.58KM $\nabla\lambda$=.95579° 29.0KM	∇u=.30220° 9.63 KM $\nabla\lambda$=.94538° 28.6 KM	∇u=.12996° 3.92 KM $\nabla\lambda$=.77759° 23.5KM	∇u=.19511° 5.90 KM $\nabla\lambda$=2.1771° 65.8 KM	∇u=.42343° 13.8 KM $\nabla\lambda$=3.7398° 113.KM	∇u= ° ND KM $\nabla\lambda$= ° ND KM	∇u=.28898° 8.77 KM $\nabla\lambda$=1.4094° 42.5KM	∇u= ° ND KM $\nabla\lambda$= ° ND KM	∇u=1.1268° 34.2KM $\nabla\lambda$=2.1864° 66.1KM
NAVIGATION	∇u=.01155° $\nabla\lambda$=.00332°	∇u=.01786° $\nabla\lambda$=.00594°	∇u=.01177° $\nabla\lambda$=.00155°	∇u=.01568° $\nabla\lambda$=.02775°	∇u=.00829° $\nabla\lambda$=.06494°	∇u= ° $\nabla\lambda$= °	∇u=.01080° $\nabla\lambda$=.00699°	∇u= ° $\nabla\lambda$= °	∇u=.03212° $\nabla\lambda$=.02653°
ATTITUDE	∇u=.15057° $\nabla\lambda$=.95568°	∇u=.30223° $\nabla\lambda$=.94523°	∇u=.12942° $\nabla\lambda$=.77754°	∇u=.19410° $\nabla\lambda$=2.1765°	∇u=.42334° $\nabla\lambda$=3.7382°	∇u= ° $\nabla\lambda$= °	∇u=.28876° $\nabla\lambda$=1.4092°	∇u= ° $\nabla\lambda$= °	∇u=1.1255° $\nabla\lambda$=2.1855°
CAMERA ON-TIME	∇u= 0 $\nabla\lambda$= 0	∇u=.00001° $\nabla\lambda$= 0	∇u= 0 $\nabla\lambda$= 0	∇u=.00001° $\nabla\lambda$=.00001°	∇u= 0 $\nabla\lambda$=.00002°	∇u= ° $\nabla\lambda$= °	∇u= 0 $\nabla\lambda$= 0	∇u= ° $\nabla\lambda$= °	∇u=.00002° $\nabla\lambda$=.00001°
MOON RADIUS	∇u=.00129° $\nabla\lambda$=.01392°	∇u=.01655° $\nabla\lambda$=.01500°	∇u=.00160° $\nabla\lambda$=.00868°	∇u=.01214° $\nabla\lambda$=.03954°	∇u=.00200° $\nabla\lambda$=.08929°	∇u=ND $\nabla\lambda$=ND	∇u=.00389° $\nabla\lambda$=.02509°	∇u=ND $\nabla\lambda$=ND	∇u=.04359° $\nabla\lambda$=.05603°

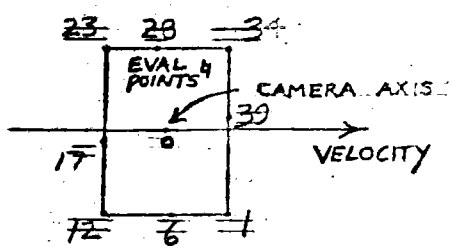
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u=.14868° 9.50 KM $\nabla\lambda$=.96539° 29.2 KM	∇u=ND ° KM $\nabla\lambda$=ND ° KM	∇u=.49040° 14.8 KM $\nabla\lambda$=.78129° 23.7 KM	∇u=ND ° KM $\nabla\lambda$=ND ° KM	∇u=ND ° KM $\nabla\lambda$=ND ° KM	∇u=ND ° KM $\nabla\lambda$=ND ° KM	∇u=ND ° KM $\nabla\lambda$=ND ° KM	∇u=ND ° KM $\nabla\lambda$=ND ° KM	∇u=ND ° KM $\nabla\lambda$=ND ° KM
NAVIGATION	∇u=.01155° $\nabla\lambda$=.00332°	∇u= $\nabla\lambda$=	∇u=.01186° $\nabla\lambda$=.00252°	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=
ATTITUDE	∇u=.14822° $\nabla\lambda$=.96528°	∇u= $\nabla\lambda$=	∇u=.49023° $\nabla\lambda$=.78123°	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=
CAMERA ON-TIME	∇u= 0 $\nabla\lambda$= 0	∇u= $\nabla\lambda$=	∇u= 0 $\nabla\lambda$= 0	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=
MOON RADIUS	∇u=.00129° $\nabla\lambda$=.01392°	∇u=ND $\nabla\lambda$=ND	∇u=.00562° $\nabla\lambda$=.00896°	∇u=ND $\nabla\lambda$=ND	∇u=ND $\nabla\lambda$=ND	∇u=ND $\nabla\lambda$=ND	∇u=ND $\nabla\lambda$=ND	∇u=ND $\nabla\lambda$=ND	∇u=ND $\nabla\lambda$=ND

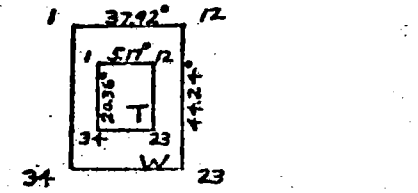
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 29





S/C ALTITUDE = ~~2546~~ KM
TRUE ANOMALY = ~~120~~ °
INCLINATION ≈ ~~85~~ °
NOTE: ~~R(68°) P(-177°) Y(0°)~~



TELEPHOTO LENS, T

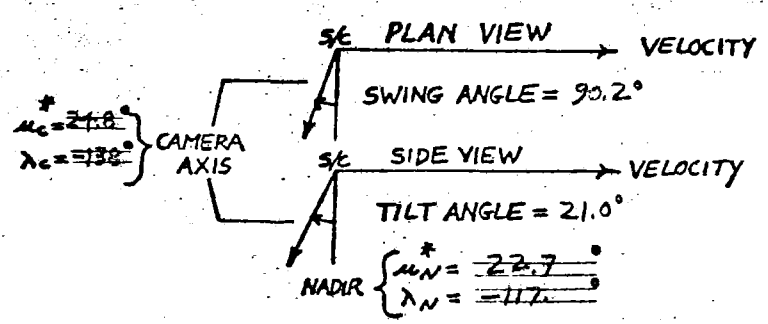
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$=.14232° 4.31 KM; $\nabla\lambda$=.69533° 21.1 KM	$\nabla\mu$=.14508° 4.40 KM; $\nabla\lambda$=1.4802° 45.0 KM	$\nabla\mu$=.12625° 3.83 KM; $\nabla\lambda$=.70508° 21.4 KM	$\nabla\mu$=.15927° 4.83 KM; $\nabla\lambda$=.50035° 15.2 KM	$\nabla\mu$=.17903° 5.85 KM; $\nabla\lambda$=.51993° 15.7 KM	$\nabla\mu$=.22574° 6.85 KM; $\nabla\lambda$=.55224° 16.8 KM	$\nabla\mu$=.17827° 5.40 KM; $\nabla\lambda$=.68832° 20.9 KM	$\nabla\mu$=.27332° 8.30 KM; $\nabla\lambda$=1.2395° 37.4 KM	$\nabla\mu$=.19961° 6.06 KM; $\nabla\lambda$=1.3809° 41.8 KM
NAVIGATION	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0
ATTITUDE	$\nabla\mu$=.14231; $\nabla\lambda$=.69522	$\nabla\mu$=.14499; $\nabla\lambda$=1.4799	$\nabla\mu$=.12624; $\nabla\lambda$=.70500	$\nabla\mu$=.15911; $\nabla\lambda$=.50030	$\nabla\mu$=.17885; $\nabla\lambda$=.51987	$\nabla\mu$=.22552; $\nabla\lambda$=.55214	$\nabla\mu$=.17823; $\nabla\lambda$=.68816	$\nabla\mu$=.27332; $\nabla\lambda$=1.2339	$\nabla\mu$=.19960; $\nabla\lambda$=1.3804
CAMERA ON-TIME	$\nabla\mu$=.00071; $\nabla\lambda$=.00084	$\nabla\mu$=.00063; $\nabla\lambda$=.00219	$\nabla\mu$=.00075; $\nabla\lambda$=.00077	$\nabla\mu$=.00097; $\nabla\lambda$=.00037	$\nabla\mu$=.00096; $\nabla\lambda$=.00040	$\nabla\mu$=.00095; $\nabla\lambda$=.00042	$\nabla\mu$=.00068; $\nabla\lambda$=.00087	$\nabla\mu$=.00030; $\nabla\lambda$=.00260	$\nabla\mu$=.00095; $\nabla\lambda$=.00260
MOON RADIUS	$\nabla\mu$=.00144; $\nabla\lambda$=.01240	$\nabla\mu$=.00506; $\nabla\lambda$=.02778	$\nabla\mu$=.00006; $\nabla\lambda$=.00979	$\nabla\mu$=.00706; $\nabla\lambda$=.00658	$\nabla\mu$=.00904; $\nabla\lambda$=.00829	$\nabla\mu$=.00991; $\nabla\lambda$=.01055	$\nabla\mu$=.00399; $\nabla\lambda$=.01456	$\nabla\mu$=.00197; $\nabla\lambda$=.04048	$\nabla\mu$=.00201; $\nabla\lambda$=.03754

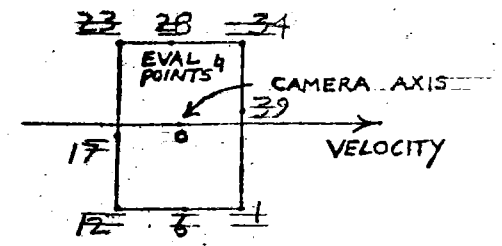
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$=.14346° 4.35 KM; $\nabla\lambda$=.70150° 21.3 KM	$\nabla\mu$=.70927° 21.5 KM; $\nabla\lambda$=1.2181° 36.7 KM	$\nabla\mu$=.27171° 8.25 KM; $\nabla\lambda$=.55990° 17.0 KM	$\nabla\mu$=.87464° 26.5 KM; $\nabla\lambda$=.47892° 14.6 KM	$\nabla\mu$=.98682° 30.0 KM; $\nabla\lambda$=.63480° 19.3 KM	$\nabla\mu$=ND° KM; $\nabla\lambda$=ND° KM	$\nabla\mu$=ND° KM; $\nabla\lambda$=ND° KM	$\nabla\mu$=ND° KM; $\nabla\lambda$=ND° KM	$\nabla\mu$=ND° KM; $\nabla\lambda$=ND° KM
NAVIGATION	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=0; $\nabla\lambda$=0	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=
ATTITUDE	$\nabla\mu$=.14345; $\nabla\lambda$=.70139	$\nabla\mu$=.70862; $\nabla\lambda$=1.2140	$\nabla\mu$=.27170; $\nabla\lambda$=.55983	$\nabla\mu$=.87382; $\nabla\lambda$=.47891	$\nabla\mu$=.98411; $\nabla\lambda$=.63440	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=
CAMERA ON-TIME	$\nabla\mu$=.00071; $\nabla\lambda$=.00084	$\nabla\mu$=.00037; $\nabla\lambda$=.00228	$\nabla\mu$=.00090; $\nabla\lambda$=.00008	$\nabla\mu$=.00330; $\nabla\lambda$=.00027	$\nabla\mu$=.00533; $\nabla\lambda$=.00100	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=	$\nabla\mu$=; $\nabla\lambda$=
MOON RADIUS	$\nabla\mu$=.00144; $\nabla\lambda$=.01240	$\nabla\mu$=.03044; $\nabla\lambda$=.05190	$\nabla\mu$=.00200; $\nabla\lambda$=.00893	$\nabla\mu$=.03783; $\nabla\lambda$=.00255	$\nabla\mu$=.07285; $\nabla\lambda$=.02241	$\nabla\mu$=ND; $\nabla\lambda$=ND	$\nabla\mu$=ND; $\nabla\lambda$=ND	$\nabla\mu$=ND; $\nabla\lambda$=ND	$\nabla\mu$=ND; $\nabla\lambda$=ND

* μ = LATITUDE λ = LONGITUDE

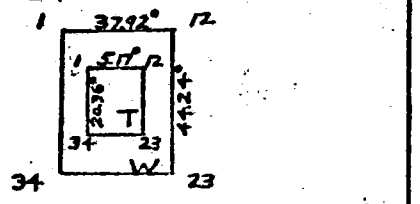
ERROR ANALYSIS RESULTS MISSION V FRAME 32





S/C ALTITUDE = ~~1395.~~ KM
TRUE ANOMALY = ~~156.~~ °
INCLINATION ≈ ~~85.~~ °
NOTE: ~~R(33°) P(160°) Y(0°)~~

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

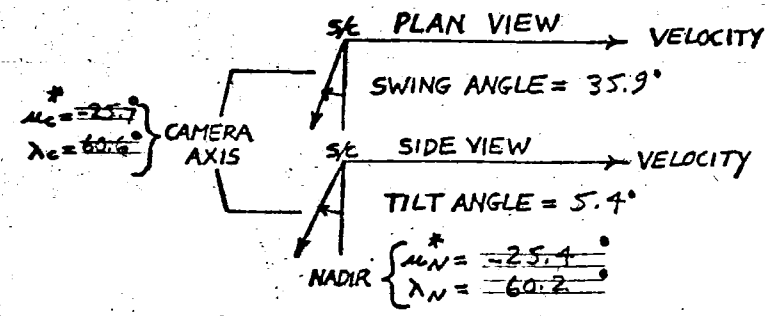
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .04240° 1.28 KM $\nabla\lambda$ = .25873° 7.57 KM	∇u = .05983° 1.81 KM $\nabla\lambda$ = .27637° 8.38 KM	∇u = .04269° 1.29 KM $\nabla\lambda$ = .23388° 7.08 KM	∇u = .04723° 1.43 KM $\nabla\lambda$ = .24004° 7.28 KM	∇u = .05082° 1.54 KM $\nabla\lambda$ = .26593° 8.01 KM	∇u = .06351° 1.92 KM $\nabla\lambda$ = .31040° 9.80 KM	∇u = .04855° 1.97 KM $\nabla\lambda$ = .29476° 8.90 KM	∇u = .06313° 1.92 KM $\nabla\lambda$ = .036760° 1.11 KM	∇u = .05932° 1.80 KM $\nabla\lambda$ = .31738° 9.60 KM
NAVIGATION	∇u = .00925 $\nabla\lambda$ = .00300	∇u = .00981 $\nabla\lambda$ = .00418	∇u = .00931 $\nabla\lambda$ = .00273	∇u = .00956 $\nabla\lambda$ = .00146	∇u = .00974 $\nabla\lambda$ = .00155	∇u = .00973 $\nabla\lambda$ = .00169	∇u = .00918 $\nabla\lambda$ = .00330	∇u = .00981 $\nabla\lambda$ = .00631	∇u = .00982 $\nabla\lambda$ = .00517
ATTITUDE	∇u = .04137 $\nabla\lambda$ = .25843	∇u = .05872 $\nabla\lambda$ = .27610	∇u = .04164 $\nabla\lambda$ = .23364	∇u = .04596 $\nabla\lambda$ = .23982	∇u = .04960 $\nabla\lambda$ = .26514	∇u = .06246 $\nabla\lambda$ = .31061	∇u = .04766 $\nabla\lambda$ = .29437	∇u = .06206 $\nabla\lambda$ = .36709	∇u = .05819 $\nabla\lambda$ = .31706
CAMERA ON-TIME	∇u = .00102 $\nabla\lambda$ = .00027	∇u = .00107 $\nabla\lambda$ = .00040	∇u = .00103 $\nabla\lambda$ = .00025	∇u = .00109 $\nabla\lambda$ = .00010	∇u = .00109 $\nabla\lambda$ = .00010	∇u = .00109 $\nabla\lambda$ = .00009	∇u = .00102 $\nabla\lambda$ = .00029	∇u = .00107 $\nabla\lambda$ = .00061	∇u = .00107 $\nabla\lambda$ = .00050
MOON RADIUS	∇u = .00037 $\nabla\lambda$ = .01216	∇u = .00577 $\nabla\lambda$ = .01133	∇u = .00096 $\nabla\lambda$ = .00998	∇u = .00472 $\nabla\lambda$ = .01028	∇u = .00519 $\nabla\lambda$ = .01228	∇u = .00607 $\nabla\lambda$ = .01540	∇u = .00492 $\nabla\lambda$ = .01486	∇u = .00605 $\nabla\lambda$ = .01828	∇u = .00595 $\nabla\lambda$ = .01464

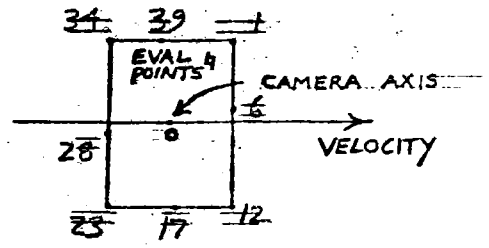
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .04081° 1.24 KM $\nabla\lambda$ = .26141° 7.90 KM	∇u = .18267° 5.54 KM $\nabla\lambda$ = .25566° 7.75 KM	∇u = .10734° 3.25 KM $\nabla\lambda$ = .17430° 5.28 KM	∇u = .14300° 4.34 KM $\nabla\lambda$ = .22224° 6.72 KM	∇u = .15392° 4.67 KM $\nabla\lambda$ = .38101° 11.6 KM	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = ND° KM $\nabla\lambda$ = ND° KM	∇u = .19596° 5.90 KM $\nabla\lambda$ = .88507° 26.8 KM
NAVIGATION	∇u = .00925 $\nabla\lambda$ = .00300	∇u = .01123 $\nabla\lambda$ = .00102	∇u = .00948 $\nabla\lambda$ = .00131	∇u = .01190 $\nabla\lambda$ = .00074	∇u = .01316 $\nabla\lambda$ = .00204	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = .01508 $\nabla\lambda$ = .002233
ATTITUDE	∇u = .03973 $\nabla\lambda$ = .26111	∇u = .18197 $\nabla\lambda$ = .25565	∇u = .10692 $\nabla\lambda$ = .17929	∇u = .14209 $\nabla\lambda$ = .22222	∇u = .15245 $\nabla\lambda$ = .38066	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = .19380 $\nabla\lambda$ = .88369
CAMERA ON-TIME	∇u = .00102 $\nabla\lambda$ = .00027	∇u = .00121 $\nabla\lambda$ = .00008	∇u = .00105 $\nabla\lambda$ = .00012	∇u = .00133 $\nabla\lambda$ = .00005	∇u = .00149 $\nabla\lambda$ = .00026	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = $\nabla\lambda$ =	∇u = .00160 $\nabla\lambda$ = .00218
MOON RADIUS	∇u = .00037 $\nabla\lambda$ = .01216	∇u = .01118 $\nabla\lambda$ = .00162	∇u = .00094 $\nabla\lambda$ = .00075	∇u = .01079 $\nabla\lambda$ = .00273	∇u = .01658 $\nabla\lambda$ = .01621	∇u = ND $\nabla\lambda$ = ND	∇u = ND $\nabla\lambda$ = ND	∇u = ND $\nabla\lambda$ = ND	∇u = .02044 $\nabla\lambda$ = .04417

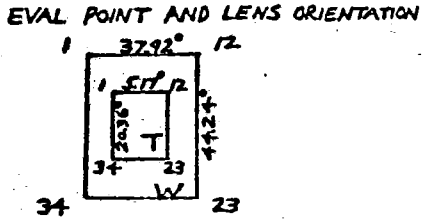
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 34





S/C ALTITUDE = 112.3 KM
TRUE ANOMALY = 333. °
INCLINATION ≈ 85. °
NOTE: R(51°) P(-9°) Y(-71°)
t4



TELEPHOTO LENS, T

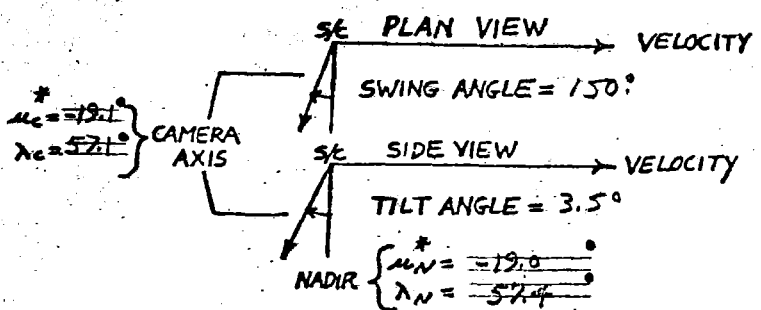
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.01962° .593 KM σ_λ=.01400° .425 KM	σ_u=.02140° .650 KM σ_λ=.01307° .396 KM	σ_u=.01960° .593 KM σ_λ=.01314° .397 KM	σ_u=.01807° .550 KM σ_λ=.01493° .453 KM	σ_u=.01824° .551 KM σ_λ=.01576° .476 KM	σ_u=.01852° .560 KM σ_λ=.01668° .507 KM	σ_u=.01971° .598 KM σ_λ=.01493° .452 KM	σ_u=.02174° .659 KM σ_λ=.01452° .440 KM	σ_u=.02156° .658 KM σ_λ=.01384° .419 KM
NAVIGATION	σ_u=.01603 σ_λ=.00172	σ_u=.01588 σ_λ=.00224	σ_u=.01592 σ_λ=.00176	σ_u=.01597 σ_λ=.00120	σ_u=.01606 σ_λ=.00119	σ_u=.01618 σ_λ=.00118	σ_u=.01614 σ_λ=.00168	σ_u=.01608 σ_λ=.00229	σ_u=.01598 σ_λ=.00227
ATTITUDE	σ_u=.01119 σ_λ=.01385	σ_u=.01428 σ_λ=.01277	σ_u=.01132 σ_λ=.01299	σ_u=.00830 σ_λ=.01431	σ_u=.00845 σ_λ=.01512	σ_u=.00870 σ_λ=.01615	σ_u=.01112 σ_λ=.01478	σ_u=.01450 σ_λ=.01423	σ_u=.01437 σ_λ=.01355
CAMERA ON-TIME	σ_u=.00149 σ_λ=.00015	σ_u=.00148 σ_λ=.00019	σ_u=.00149 σ_λ=.00015	σ_u=.00149 σ_λ=.00010	σ_u=.00150 σ_λ=.00010	σ_u=.00151 σ_λ=.00010	σ_u=.00150 σ_λ=.00014	σ_u=.00150 σ_λ=.00019	σ_u=.00149 σ_λ=.00019
MOON RADIUS	σ_u=.00089 σ_λ=.00112	σ_u= 0 σ_λ=.00161	σ_u=.00022 σ_λ=.00093	σ_u=.00045 σ_λ=.00407	σ_u=.00104 σ_λ=.00403	σ_u=.00176 σ_λ=.00399	σ_u=.00155 σ_λ=.00132	σ_u=.00127 σ_λ=.00177	σ_u=.00069 σ_λ=.00169

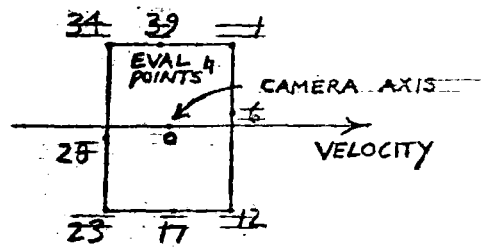
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.02029° .616 KM σ_λ=.01463° .442 KM	σ_u=.02680° .813 KM σ_λ=.01234° .374 KM	σ_u=.02083° .660 KM σ_λ=.01020° .310 KM	σ_u=.01765° .536 KM σ_λ=.01570° .475 KM	σ_u=.01759° .532 KM σ_λ=.02035° .619 KM	σ_u=.02141° .650 KM σ_λ=.03056° .920 KM	σ_u=.02357° .716 KM σ_λ=.02245° .682 KM	σ_u=.02827° .860 KM σ_λ=.02178° .661 KM	σ_u=.02574° .780 KM σ_λ=.01659° .500 KM
NAVIGATION	σ_u=.01603 σ_λ=.00172	σ_u=.01532 σ_λ=.00265	σ_u=.01540 σ_λ=.00175	σ_u=.01546 σ_λ=.00833	σ_u=.01605 σ_λ=.00703	σ_u=.01720 σ_λ=.00061	σ_u=.01703 σ_λ=.00169	σ_u=.01684 σ_λ=.00336	σ_u=.01597 σ_λ=.00229
ATTITUDE	σ_u=.01232 σ_λ=.01448	σ_u=.02149 σ_λ=.01119	σ_u=.01337 σ_λ=.01000	σ_u=.00750 σ_λ=.01338	σ_u=.00698 σ_λ=.01872	σ_u=.01071 σ_λ=.02952	σ_u=.01506 σ_λ=.02235	σ_u=.02204 σ_λ=.02066	σ_u=.02012 σ_λ=.01541
CAMERA ON-TIME	σ_u=.00149 σ_λ=.00015	σ_u=.00145 σ_λ=.00022	σ_u=.00145 σ_λ=.00015	σ_u=.00146 σ_λ=.00007	σ_u=.00150 σ_λ=.00005	σ_u=.00158 σ_λ=.00002	σ_u=.00157 σ_λ=.00014	σ_u=.00156 σ_λ=.00018	σ_u=.00149 σ_λ=.00024
MOON RADIUS	σ_u=.00088 σ_λ=.00112	σ_u=.00441 σ_λ=.00448	σ_u=.00398 σ_λ=.00104	σ_u=.00374 σ_λ=.00817	σ_u=.00090 σ_λ=.00796	σ_u=.00673 σ_λ=.00790	σ_u=.00601 σ_λ=.00123	σ_u=.00520 σ_λ=.00600	σ_u=.00071 σ_λ=.00522

* σ_u = LATITUDE σ_λ = LONGITUDE

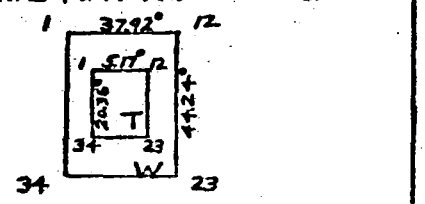
ERROR ANALYSIS RESULTS MISSION V FRAME 37





S/C ALTITUDE = 122.8 KM
TRUE ANOMALY = 340. °
INCLINATION = 85. °
NOTE: R(48°) P(-12°) Y(-69°)

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

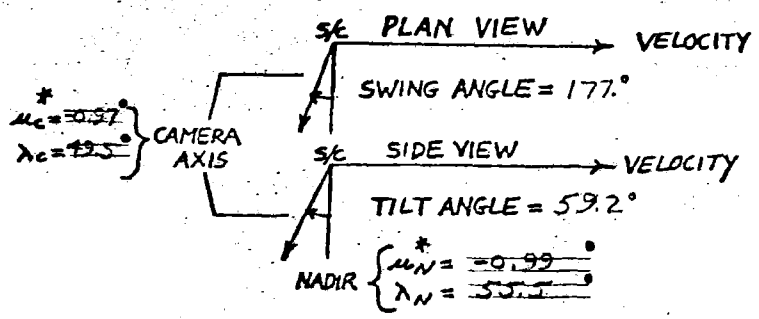
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.01497° .455 KM σ_λ=.01130° .343 KM	σ_u=.01663° .503 KM σ_λ=.01177° .355 KM	σ_u=.01488° .452 KM σ_λ=.01074° .325 KM	σ_u=.01349° .410 KM σ_λ=.01115° .337 KM	σ_u=.01373° .415 KM σ_λ=.01169° .355 KM	σ_u=.01407° .427 KM σ_λ=.01238° .375 KM	σ_u=.01511° .458 KM σ_λ=.01890° .572 KM	σ_u=.01700° .515 KM σ_λ=.01291° .392 KM	σ_u=.01680° .510 KM σ_λ=.01238° .375 KM
NAVIGATION	σ_u=.01167 σ_λ=.00166	σ_u=.01131 σ_λ=.00271	σ_u=.01142 σ_λ=.00173	σ_u=.01153 σ_λ=.00063	σ_u=.01175 σ_λ=.00064	σ_u=.01202 σ_λ=.00066	σ_u=.01193 σ_λ=.00160	σ_u=.01181 σ_λ=.00279	σ_u=.01158 σ_λ=.00275
ATTITUDE	σ_u=.00919 σ_λ=.01114	σ_u=.01204 σ_λ=.01093	σ_u=.00938 σ_λ=.01056	σ_u=.00678 σ_λ=.01097	σ_u=.00686 σ_λ=.01153	σ_u=.00699 σ_λ=.01224	σ_u=.00905 σ_λ=.01177	σ_u=.01208 σ_λ=.01208	σ_u=.01209 σ_λ=.01159
CAMERA ON-TIME	σ_u=.00177 σ_λ=.00019	σ_u=.00176 σ_λ=.00022	σ_u=.00177 σ_λ=.00019	σ_u=.00177 σ_λ=.00015	σ_u=.00177 σ_λ=.00015	σ_u=.00178 σ_λ=.00015	σ_u=.00178 σ_λ=.00019	σ_u=.00178 σ_λ=.00022	σ_u=.00177 σ_λ=.00022
MOON RADIUS	σ_u=.00035 σ_λ=.00082	σ_u=.00086 σ_λ=.00345	σ_u=.00031 σ_λ=.00099	σ_u=.00004 σ_λ=.00188	σ_u=.00053 σ_λ=.00183	σ_u=.00122 σ_λ=.00176	σ_u=.00100 σ_λ=.00865	σ_u=.00072 σ_λ=.00361	σ_u=.00013 σ_λ=.00353

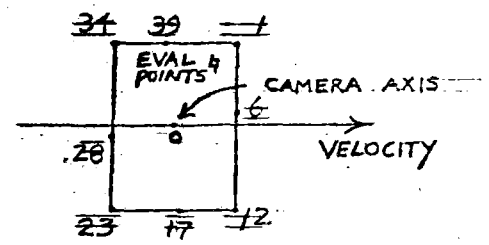
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.01555° .470 KM σ_λ=.01177° .356 KM	σ_u=.02208° .670 KM σ_λ=.01290° .392 KM	σ_u=.01578° .478 KM σ_λ=.00862° .261 KM	σ_u=.01256° .380 KM σ_λ=.01144° .346 KM	σ_u=.01313° .397 KM σ_λ=.01439° .434 KM	σ_u=.01697° .515 KM σ_λ=.02067° .628 KM	σ_u=.01871° .568 KM σ_λ=.01728° .525 KM	σ_u=.02306° .700 KM σ_λ=.02073° .627 KM	σ_u=.02088° .634 KM σ_λ=.01639° .498 KM
NAVIGATION	σ_u=.01167 σ_λ=.00166	σ_u=.00960 σ_λ=.00378	σ_u=.00999 σ_λ=.00163	σ_u=.01013 σ_λ=.00092	σ_u=.01172 σ_λ=.00088	σ_u=.01389 σ_λ=.00089	σ_u=.01370 σ_λ=.00170	σ_u=.01397 σ_λ=.00972	σ_u=.01157 σ_λ=.00929
ATTITUDE	σ_u=.01012 σ_λ=.01163	σ_u=.01901 σ_λ=.01051	σ_u=.01130 σ_λ=.00843	σ_u=.00608 σ_λ=.00897	σ_u=.00569 σ_λ=.01335	σ_u=.00767 σ_λ=.02008	σ_u=.01144 σ_λ=.01717	σ_u=.01800 σ_λ=.01857	σ_u=.01728 σ_λ=.01412
CAMERA ON-TIME	σ_u=.00177 σ_λ=.00019	σ_u=.00173 σ_λ=.00023	σ_u=.00174 σ_λ=.00018	σ_u=.00174 σ_λ=.00012	σ_u=.00177 σ_λ=.00011	σ_u=.00185 σ_λ=.00010	σ_u=.00184 σ_λ=.00019	σ_u=.00183 σ_λ=.00031	σ_u=.00177 σ_λ=.00027
MOON RADIUS	σ_u=.00035 σ_λ=.00082	σ_u=.00527 σ_λ=.00644	σ_u=.00451 σ_λ=.00082	σ_u=.00387 σ_λ=.00533	σ_u=.00045 σ_λ=.00517	σ_u=.00574 σ_λ=.00481	σ_u=.00530 σ_λ=.00084	σ_u=.00477 σ_λ=.00791	σ_u=.00013 σ_λ=.00715

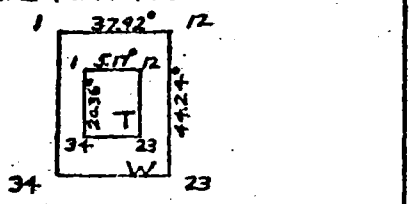
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 38





S/C ALTITUDE = 98.0 KM
TRUE ANOMALY = 358.°
INCLINATION = 85.°
NOTE: APOLLO TGT. NO. 3.1
R(9°) Y(-8°) P(-68°)



TELEPHOTO LENS, T

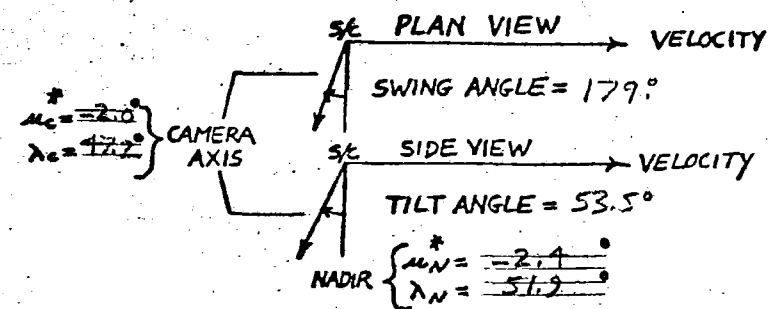
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.01842° .558 KM σ_λ=.19028° 5.76 KM	σ_u=.07445° 2.25 KM σ_λ=1.03164° 31.3 KM	σ_u=.02320° .703 KM σ_λ=.20545° 6.22 KM	σ_u=.01599° .484 KM σ_λ=.09752° 2.96 KM	σ_u=.01479° .448 KM σ_λ=.09776° 2.96 KM	σ_u=.01428° .432 KM σ_λ=.09814° 2.98 KM	σ_u=.01724° .522 KM σ_λ=.17727° 5.30 KM	σ_u=.03362° 1.17 KM σ_λ=1.13589° 34.4 KM	σ_u=.03510° 1.06 KM σ_λ=1.07715° 32.6 KM
NAVIGATION	σ_u=.00768° σ_λ=.00521°	σ_u=.00682° σ_λ=.01532°	σ_u=.00744° σ_λ=.00535°	σ_u=.00757° σ_λ=.00337°	σ_u=.00771° σ_λ=.00342°	σ_u=.00789° σ_λ=.00348°	σ_u=.00792° σ_λ=.00509°	σ_u=.00822° σ_λ=.01786°	σ_u=.00753° σ_λ=.01652°
ATTITUDE	σ_u=.01665° σ_λ=.18811°	σ_u=.07396° σ_λ=1.02862°	σ_u=.02184° σ_λ=.20326°	σ_u=.01374° σ_λ=.09593°	σ_u=.01250° σ_λ=.09616°	σ_u=.01171° σ_λ=.09652°	σ_u=.01515° σ_λ=.17515°	σ_u=.03760° σ_λ=1.13280°	σ_u=.03423° σ_λ=1.07409°
CAMERA ON-TIME	σ_u=.00179° σ_λ=.00023°	σ_u=.00178° σ_λ=.00033°	σ_u=.00179° σ_λ=.00021°	σ_u=.00179° σ_λ=.00019°	σ_u=.00179° σ_λ=.00019°	σ_u=.00180° σ_λ=.00020°	σ_u=.00180° σ_λ=.00024°	σ_u=.00181° σ_λ=.00059°	σ_u=.00179° σ_λ=.00046°
MOON RADIUS	σ_u=.00015° σ_λ=.02805°	σ_u=.00480° σ_λ=.07739°	σ_u=.00170° σ_λ=.02943°	σ_u=.00090° σ_λ=.01721°	σ_u=.00001° σ_λ=.01729°	σ_u=.00113° σ_λ=.01740°	σ_u=.00130° σ_λ=.02684°	σ_u=.00254° σ_λ=.08180°	σ_u=.00089° σ_λ=.07938°

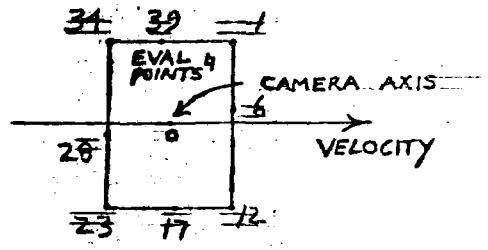
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.01886° .570 KM σ_λ=.19722° 5.98 KM	σ_u=ND° KM σ_λ=ND° KM	σ_u=.08702° 2.64 KM σ_λ=.23901° 7.24 KM	σ_u=.02194° .664 KM σ_λ=.06351° 1.92 KM	σ_u=.01341° .407 KM σ_λ=.06330° 1.92 KM	σ_u=.01755° .531 KM σ_λ=.06449° 1.95 KM	σ_u=.05465° 1.66 KM σ_λ=.18331° 5.55 KM	σ_u=ND° KM σ_λ=ND° KM	σ_u=ND° KM σ_λ=ND° KM
NAVIGATION	σ_u=.00768° σ_λ=.00521°	σ_u= σ_λ=	σ_u=.00605° σ_λ=.00493°	σ_u=.00695° σ_λ=.00223°	σ_u=.00767° σ_λ=.00239°	σ_u=.00875° σ_λ=.00264°	σ_u=.00971° σ_λ=.00530°	σ_u= σ_λ=	σ_u= σ_λ=
ATTITUDE	σ_u=.01713° σ_λ=.19514°	σ_u= σ_λ=	σ_u=.08589° σ_λ=.23691°	σ_u=.02002° σ_λ=.06259°	σ_u=.01085° σ_λ=.06233°	σ_u=.01380° σ_λ=.06343°	σ_u=.05264° σ_λ=.18116°	σ_u= σ_λ=	σ_u= σ_λ=
CAMERA ON-TIME	σ_u=.00179° σ_λ=.00023°	σ_u= σ_λ=	σ_u=.00184° σ_λ=.00004°	σ_u=.00180° σ_λ=.00014°	σ_u=.00179° σ_λ=.00017°	σ_u=.00182° σ_λ=.00021°	σ_u=.00188° σ_λ=.00038°	σ_u= σ_λ=	σ_u= σ_λ=
MOON RADIUS	σ_u=.00015° σ_λ=.02805°	σ_u= σ_λ=	σ_u=.01249° σ_λ=.03122°	σ_u=.00539° σ_λ=.01059°	σ_u=.00023° σ_λ=.01081°	σ_u=.00615° σ_λ=.01134°	σ_u=.01089° σ_λ=.02741°	σ_u= σ_λ=	σ_u= σ_λ=

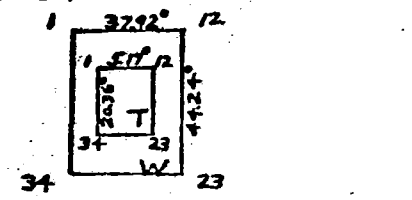
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 41





S/C ALTITUDE = ~~98.3~~ KM
TRUE ANOMALY = ~~356.~~ °
INCLINATION = ~~85.~~ °
NOTE: ~~R(96°) Y(14°) P(63°)~~



TELEPHOTO LENS, T

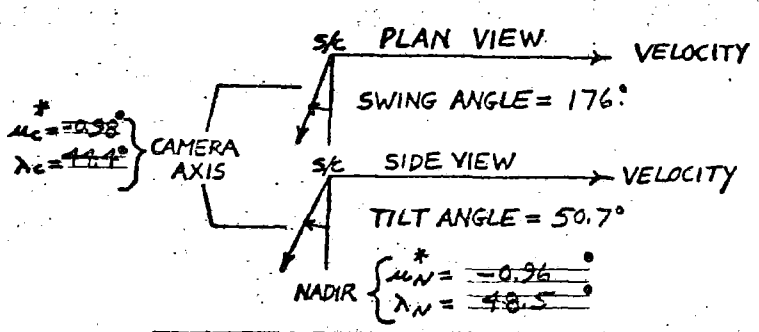
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.02692° .817 KM σ_λ=.11581° 3.51 KM	σ_u=.04973° .151 KM σ_λ=.27915° .848 KM	σ_u=.02990° .908 KM σ_λ=.12224° 3.70 KM	σ_u=.02441° .740 KM σ_λ=.07006° .213 KM	σ_u=.02381° .721 KM σ_λ=.07029° .213 KM	σ_u=.02337° .710 KM σ_λ=.07063° .214 KM	σ_u=.02513° .761 KM σ_λ=.11012° 3.35 KM	σ_u=.03300° 1.00 KM σ_λ=.28184° 8.54 KM	σ_u=.03967° 1.21 KM σ_λ=.28072° 8.53 KM
NAVIGATION	σ_u=.01874 σ_λ=.01143	σ_u=.01711 σ_λ=.01915	σ_u=.01817 σ_λ=.01164	σ_u=.01867 σ_λ=.00796	σ_u=.01903 σ_λ=.00807	σ_u=.01947 σ_λ=.00820	σ_u=.01929 σ_λ=.01123	σ_u=.01878 σ_λ=.02021	σ_u=.01800 σ_λ=.01970
ATTITUDE	σ_u=.01915 σ_λ=.11333	σ_u=.04634 σ_λ=.27596	σ_u=.02347 σ_λ=.11974	σ_u=.01548 σ_λ=.06826	σ_u=.01413 σ_λ=.06847	σ_u=.01281 σ_λ=.06877	σ_u=.01599 σ_λ=.10767	σ_u=.02703 σ_λ=.27954	σ_u=.03515 σ_λ=.27747
CAMERA ON-TIME	σ_u=.00179 σ_λ=.00020	σ_u=.00179 σ_λ=.00020	σ_u=.00179 σ_λ=.00019	σ_u=.00179 σ_λ=.00018	σ_u=.00179 σ_λ=.00018	σ_u=.00179 σ_λ=.00019	σ_u=.00179 σ_λ=.00021	σ_u=.00179 σ_λ=.00027	σ_u=.00179 σ_λ=.00024
MOON RADIUS	σ_u=.00189 σ_λ=.02090	σ_u=.00540 σ_λ=.03750	σ_u=.00318 σ_λ=.02168	σ_u=.00207 σ_λ=.01363	σ_u=.00127 σ_λ=.01371	σ_u=.00030 σ_λ=.01382	σ_u=.00067 σ_λ=.02018	σ_u=.00170 σ_λ=.03802	σ_u=.00338 σ_λ=.03774

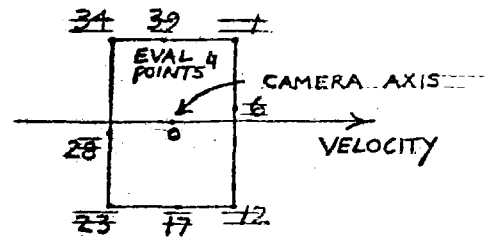
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.02743° .830 KM σ_λ=.12011° 3.65 KM	σ_u=ND° KM σ_λ=ND° KM	σ_u=.06415° 1.95 KM σ_λ=.13741° 4.15 KM	σ_u=.02626° .798 KM σ_λ=.04949° 1.50 KM	σ_u=.02270° .689 KM σ_λ=.05003° 1.52 KM	σ_u=.02484° .753 KM σ_λ=.05187° 1.57 KM	σ_u=.03375° 1.03 KM σ_λ=.11323° 3.42 KM	σ_u=ND° KM σ_λ=ND° KM	σ_u=ND° KM σ_λ=ND° KM
NAVIGATION	σ_u=.01874 σ_λ=.11431	σ_u= σ_λ=	σ_u=.01483 σ_λ=.01090	σ_u=.01709 σ_λ=.00525	σ_u=.01909 σ_λ=.00569	σ_u=.02186 σ_λ=.00633	σ_u=.02309 σ_λ=.01235	σ_u= σ_λ=	σ_u= σ_λ=
ATTITUDE	σ_u=.01986 σ_λ=.11772	σ_u= σ_λ=	σ_u=.06125 σ_λ=.13512	σ_u=.01894 σ_λ=.04853	σ_u=.01210 σ_λ=.04896	σ_u=.01071 σ_λ=.05034	σ_u=.02359 σ_λ=.11067	σ_u= σ_λ=	σ_u= σ_λ=
CAMERA ON-TIME	σ_u=.00179 σ_λ=.00020	σ_u= σ_λ=	σ_u=.00183 σ_λ=.00009	σ_u=.00180 σ_λ=.00015	σ_u=.00179 σ_λ=.00017	σ_u=.00182 σ_λ=.00020	σ_u=.00184 σ_λ=.00029	σ_u= σ_λ=	σ_u= σ_λ=
MOON RADIUS	σ_u=.00189 σ_λ=.02090	σ_u=ND σ_λ=ND	σ_u=.01184 σ_λ=.02248	σ_u=.00597 σ_λ=.00814	σ_u=.00115 σ_λ=.00857	σ_u=.00461 σ_λ=.00923	σ_u=.00682 σ_λ=.02052	σ_u=ND σ_λ=ND	σ_u=ND σ_λ=ND

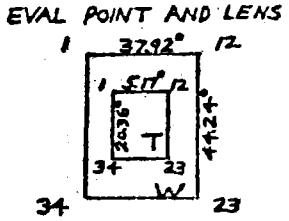
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 42





S/C ALTITUDE = 97.3 KM
TRUE ANOMALY = 358 °
INCLINATION ≈ 85 °
NOTE: APOLLO TGT. V-6
R(95°) Y(-17°) P(-67°)



TELEPHOTO LENS, T

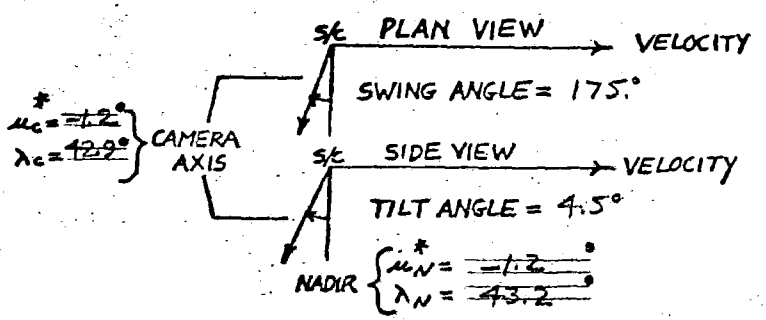
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_μ=.01465° .445KM ∇_λ=.10541° 3.20KM	∇_μ=.02480° .751 KM ∇_λ=.21692° 6.57 KM	∇_μ=.01695° .514 KM ∇_λ=.11031° 3.34 KM	∇_μ=.01348° .409 KM ∇_λ=.06749° 2.04 KM	∇_μ=.01267° .384 KM ∇_λ=.06768° 2.05 KM	∇_μ=.01213° .368 KM ∇_λ=.06794° 2.06 KM	∇_μ=.01356° .411 KM ∇_λ=.10097° 3.06 KM	∇_μ=.01797° .526 KM ∇_λ=.22192° 6.72 KM	∇_μ=.01906° .577 KM ∇_λ=.21939° 6.64 KM
NAVIGATION	∇_μ=.00553 ∇_λ=.00252	∇_μ=.00535 ∇_λ=.00370	∇_μ=.00543 ∇_λ=.00255	∇_μ=.00547 ∇_λ=.00190	∇_μ=.00554 ∇_λ=.00192	∇_μ=.00563 ∇_λ=.00195	∇_μ=.00564 ∇_λ=.00250	∇_μ=.00565 ∇_λ=.00392	∇_μ=.00551 ∇_λ=.00382
ATTITUDE	∇_μ=.01345 ∇_λ=.10373	∇_μ=.02407 ∇_λ=.21471	∇_μ=.01592 ∇_λ=.10861	∇_μ=.01217 ∇_λ=.06633	∇_μ=.01125 ∇_λ=.06651	∇_μ=.01053 ∇_λ=.06676	∇_μ=.01215 ∇_λ=.09933	∇_μ=.01628 ∇_λ=.21966	∇_μ=.01815 ∇_λ=.21715
CAMERA ON-TIME	∇_μ=.00179 ∇_λ=.00019	∇_μ=.00179 ∇_λ=.00020	∇_μ=.00179 ∇_λ=.00018	∇_μ=.00179 ∇_λ=.00017	∇_μ=.00180 ∇_λ=.00018	∇_μ=.00180 ∇_λ=.00018	∇_μ=.00180 ∇_λ=.00020	∇_μ=.00180 ∇_λ=.00025	∇_μ=.00179 ∇_λ=.00023
MOON RADIUS	∇_μ=.00007 ∇_λ=.01854	∇_μ=.00186 ∇_λ=.03068	∇_μ=.00105 ∇_λ=.01916	∇_μ=.00057 ∇_λ=.01230	∇_μ=.00020 ∇_λ=.01237	∇_μ=.00112 ∇_λ=.01246	∇_μ=.00115 ∇_λ=.01796	∇_μ=.00127 ∇_λ=.03130	∇_μ=.00017 ∇_λ=.03100

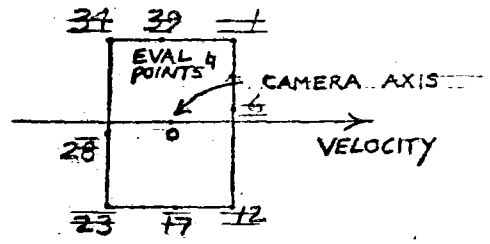
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇_μ=.01507° .465 KM ∇_λ=.10923° 3.32 KM	∇_μ=ND° KM ∇_λ=ND° KM	∇_μ=.04513° 1.37 KM ∇_λ=.12056° 3.65 KM	∇_μ=.01766° .535 KM ∇_λ=.04991° 1.51 KM	∇_μ=.01193° .362 KM ∇_λ=.05011° 1.52 KM	∇_μ=.01362° .413 KM ∇_λ=.05112° 1.55 KM	∇_μ=.02832° .957 KM ∇_λ=.10448° 3.16 KM	∇_μ=ND° KM ∇_λ=ND° KM	∇_μ=ND° KM ∇_λ=ND° KM
NAVIGATION	∇_μ=.00553 ∇_λ=.00252	∇_μ= ∇_λ=	∇_μ=.00484 ∇_λ=.00235	∇_μ=.00514 ∇_λ=.00141	∇_μ=.00553 ∇_λ=.00148	∇_μ=.00610 ∇_λ=.00160	∇_μ=.00642 ∇_λ=.00275	∇_μ= ∇_λ=	∇_μ= ∇_λ=
ATTITUDE	∇_μ=.01390 ∇_λ=.10762	∇_μ= ∇_λ=	∇_μ=.04402 ∇_λ=.11894	∇_μ=.01616 ∇_λ=.04934	∇_μ=.01042 ∇_λ=.04950	∇_μ=.01061 ∇_λ=.05044	∇_μ=.02623 ∇_λ=.10282	∇_μ= ∇_λ=	∇_μ= ∇_λ=
CAMERA ON-TIME	∇_μ=.00179 ∇_λ=.00019	∇_μ= ∇_λ=	∇_μ=.00182 ∇_λ=.00011	∇_μ=.00180 ∇_λ=.00015	∇_μ=.00179 ∇_λ=.00016	∇_μ=.00182 ∇_λ=.00019	∇_μ=.00185 ∇_λ=.00027	∇_μ= ∇_λ=	∇_μ= ∇_λ=
MOON RADIUS	∇_μ=.00007 ∇_λ=.01854	∇_μ= ∇_λ=	∇_μ=.00851 ∇_λ=.01956	∇_μ=.00460 ∇_λ=.00741	∇_μ=.00001 ∇_λ=.00767	∇_μ=.00570 ∇_λ=.00813	∇_μ=.00831 ∇_λ=.01833	∇_μ= ∇_λ=	∇_μ= ∇_λ=

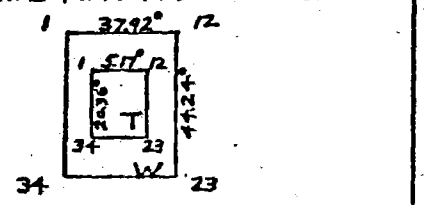
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 45





S/C ALTITUDE = 97.0 KM
TRUE ANOMALY = 358 °
INCLINATION ≈ 85 °
NOTE: APOLLO TST. VEH. 8A
R(32°) P(-22°) Y(-74°) ±4



TELEPHOTO LENS, T

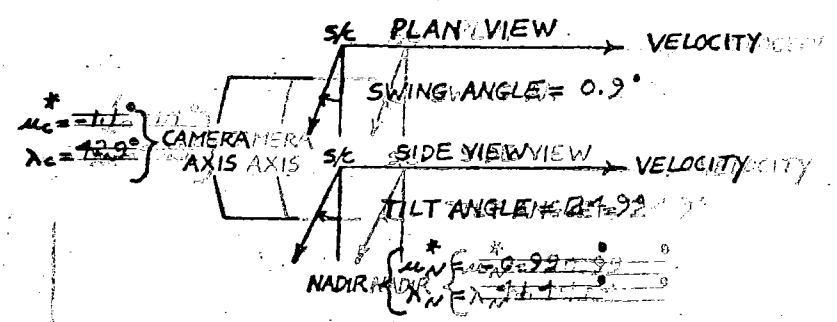
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.01158° .351 KM σ_λ=.00813° .246KM	σ_u=.01303° .396 KM σ_λ=.00885° .268 KM	σ_u=.01165° .353KM σ_λ=.00779° .236 KM	σ_u=.01055° .320 KM σ_λ=.00795° .241 KM	σ_u=.01061° .322KM σ_λ=.00831° .252KM	σ_u=.01073° .326 KM σ_λ=.00877° .266 KM	σ_u=.01156° .350 KM σ_λ=.00852° .258 KM	σ_u=.01308° .396 KM σ_λ=.00962° .292 KM	σ_u=.01303° .395 KM σ_λ=.00826° .250 KM
NAVIGATION	σ_u=.00939 σ_λ=.00101	σ_u=.00931 σ_λ=.00123	σ_u=.00933 σ_λ=.00102	σ_u=.00935 σ_λ=.00080	σ_u=.00940 σ_λ=.00080	σ_u=.00946 σ_λ=.00080	σ_u=.00945 σ_λ=.00100	σ_u=.00942 σ_λ=.00125	σ_u=.00937 σ_λ=.00124
ATTITUDE	σ_u=.00661 σ_λ=.00800	σ_u=.00896 σ_λ=.00801	σ_u=.00678 σ_λ=.00762	σ_u=.00463 σ_λ=.00778	σ_u=.00467 σ_λ=.00815	σ_u=.00475 σ_λ=.00863	σ_u=.00646 σ_λ=.00842	σ_u=.00893 σ_λ=.00880	σ_u=.00893 σ_λ=.00843
CAMERA ON-TIME	σ_u=.00152 σ_λ=.00013	σ_u=.00152 σ_λ=.00013	σ_u=.00152 σ_λ=.00013	σ_u=.00152 σ_λ=.00013	σ_u=.00152 σ_λ=.00013	σ_u=.00152 σ_λ=.00013	σ_u=.00152 σ_λ=.00013	σ_u=.00152 σ_λ=.00014	σ_u=.00152 σ_λ=.00013
MOON RADIUS	σ_u=.000003 σ_λ=.00108	σ_u=.00086 σ_λ=.00356	σ_u=.00064 σ_λ=.00125	σ_u=.00040 σ_λ=.00144	σ_u=.00016 σ_λ=.00139	σ_u=.00084 σ_λ=.00133	σ_u=.00065 σ_λ=.00091	σ_u=.00041 σ_λ=.00368	σ_u=.00016 σ_λ=.00363

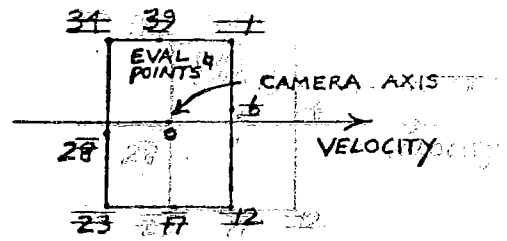
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.01201° .364 KM σ_λ=.00842° .255 KM	σ_u=.01812° .550 KM σ_λ=.01052° .319 KM	σ_u=.01330° .403 KM σ_λ=.00653° .198KM	σ_u=.01087° .329KM σ_λ=.00873° .264 KM	σ_u=.01020° .309 KM σ_λ=.01027° .311 KM	σ_u=.01231° .373KM σ_λ=.01424° .431 KM	σ_u=.01369° .415 KM σ_λ=.01213° .368 KM	σ_u=.01723° .522 KM σ_λ=.01557° .471 KM	σ_u=.01616° .490 KM σ_λ=.01271° .386 KM
NAVIGATION	σ_u=.00939 σ_λ=.00101	σ_u=.00896 σ_λ=.00141	σ_u=.00901 σ_λ=.00100	σ_u=.00906 σ_λ=.00059	σ_u=.00939 σ_λ=.00056	σ_u=.00993 σ_λ=.00054	σ_u=.00990 σ_λ=.00102	σ_u=.00987 σ_λ=.00170	σ_u=.00938 σ_λ=.00156
ATTITUDE	σ_u=.00733 σ_λ=.00829	σ_u=.01468 σ_λ=.00807	σ_u=.00838 σ_λ=.00635	σ_u=.00405 σ_λ=.00724	σ_u=.00368 σ_λ=.00924	σ_u=.00489 σ_λ=.01364	σ_u=.00798 σ_λ=.01204	σ_u=.01330 σ_λ=.01353	σ_u=.01307 σ_λ=.01046
CAMERA ON-TIME	σ_u=.00152 σ_λ=.00013	σ_u=.00153 σ_λ=.00012	σ_u=.00153 σ_λ=.00013	σ_u=.00153 σ_λ=.00014	σ_u=.00152 σ_λ=.00013	σ_u=.00154 σ_λ=.00012	σ_u=.00154 σ_λ=.00013	σ_u=.00154 σ_λ=.00016	σ_u=.00152 σ_λ=.00014
MOON RADIUS	σ_u=.000003 σ_λ=.00108	σ_u=.00552 σ_λ=.00659	σ_u=.00483 σ_λ=.00115	σ_u=.00417 σ_λ=.00484	σ_u=.00008 σ_λ=.00445	σ_u=.00516 σ_λ=.00405	σ_u=.00483 σ_λ=.00102	σ_u=.00450 σ_λ=.00752	σ_u=.00008 σ_λ=.00704

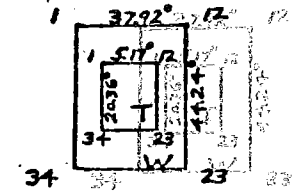
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 149





S/C ALTITUDE = 96.9 KM
TRUE ANOMALY = 350 °
INCLINATION = 85 °
NOTE: APOLLO TGT V-8B



TELEPHOTO LENS, T

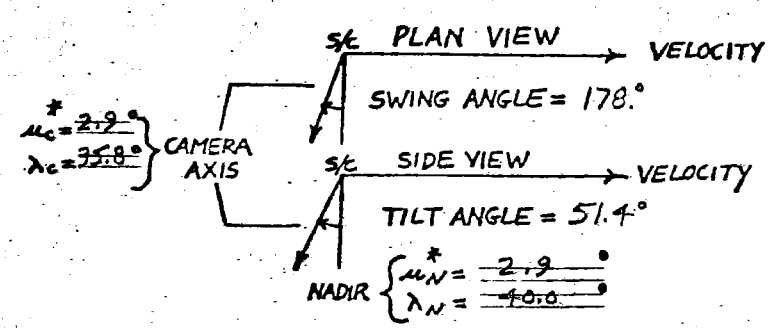
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .01607° .486 KM σ_λ = .01188° .3600 KM	σ_μ = .01694° .514 KM σ_λ = .00879° .266 KM	σ_μ = .01588° .4810 KM σ_λ = .01113° .3372 KM	σ_μ = .01487° .4504 KM σ_λ = .01575° .4772 KM	σ_μ = .01518° .4600 KM σ_λ = .01625° .4924 KM	σ_μ = .01563° .4736 KM σ_λ = .01694° .5134 KM	σ_μ = .01634° .4950 KM σ_λ = .01272° .3856 KM	σ_μ = .01745° .5289 KM σ_λ = .00961° .2911 KM	σ_μ = .01719° .5210 KM σ_λ = .00922° .2794 KM
NAVIGATION	σ_μ = .01373 σ_λ = .00098	σ_μ = .01346 σ_λ = .00066	σ_μ = .01351 σ_λ = .00092	σ_μ = .01358 σ_λ = .00190	σ_μ = .01379 σ_λ = .00191	σ_μ = .01405 σ_λ = .00193	σ_μ = .01395 σ_λ = .00105	σ_μ = .01385 σ_λ = .00067	σ_μ = .01367 σ_λ = .00067
ATTITUDE	σ_μ = .00814 σ_λ = .00991	σ_μ = .01013 σ_λ = .00795	σ_μ = .00815 σ_λ = .00915	σ_μ = .00577 σ_λ = .01199	σ_μ = .00600 σ_λ = .01269	σ_μ = .00638 σ_λ = .01360	σ_μ = .00821 σ_λ = .01075	σ_μ = .01041 σ_λ = .00889	σ_μ = .01026 σ_λ = .00844
CAMERA ON-TIME	σ_μ = .00180 σ_λ = .00015	σ_μ = .00180 σ_λ = .00015	σ_μ = .00180 σ_λ = .00015	σ_μ = .00180 σ_λ = .00015	σ_μ = .00180 σ_λ = .00014	σ_μ = .00180 σ_λ = .00014	σ_μ = .00180 σ_λ = .00014	σ_μ = .00180 σ_λ = .00015	σ_μ = .00180 σ_λ = .00015
MOON RADIUS	σ_μ = .00065 σ_λ = .00649	σ_μ = .00023 σ_λ = .00369	σ_μ = .00006 σ_λ = .00626	σ_μ = .00018 σ_λ = .01003	σ_μ = .00088 σ_λ = .00998	σ_μ = .00172 σ_λ = .00991	σ_μ = .00138 σ_λ = .00676	σ_μ = .00104 σ_λ = .00359	σ_μ = .00047 σ_λ = .00364

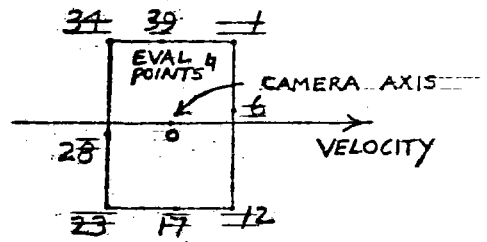
WIDE ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .01657° .501 KM σ_λ = .01219° .369 KM	σ_μ = .01975° .598 KM σ_λ = .00638° .193 KM	σ_μ = .01656° .5011 KM σ_λ = .00986° .2983 KM	σ_μ = .01452° .4396 KM σ_λ = .02279° .6897 KM	σ_μ = .01476° .4467 KM σ_λ = .02575° .7794 KM	σ_μ = .02224° .6731 KM σ_λ = .03596° .7619 KM	σ_μ = .02120° .6416 KM σ_λ = .01814° .5491 KM	σ_μ = .02230° .6750 KM σ_λ = .01130° .3421 KM	σ_μ = .01850° .5599 KM σ_λ = .00827° .2510 KM
NAVIGATION	σ_μ = .01373 σ_λ = .00098	σ_μ = .01233 σ_λ = .00114	σ_μ = .01224 σ_λ = .00086	σ_μ = .01202 σ_λ = .00342	σ_μ = .01378 σ_λ = .00364	σ_μ = .01635 σ_λ = .00404	σ_μ = .01553 σ_λ = .00116	σ_μ = .01500 σ_λ = .00131	σ_μ = .01369 σ_λ = .00123
ATTITUDE	σ_μ = .00908 σ_λ = .01229	σ_μ = .01473 σ_λ = .00619	σ_μ = .00998 σ_λ = .00746	σ_μ = .00574 σ_λ = .01524	σ_μ = .00488 σ_λ = .01992	σ_μ = .01233 σ_λ = .03216	σ_μ = .01292 σ_λ = .01680	σ_μ = .01525 σ_λ = .01240	σ_μ = .01377 σ_λ = .00815
CAMERA ON-TIME	σ_μ = .00180 σ_λ = .00015	σ_μ = .00180 σ_λ = .00015	σ_μ = .00180 σ_λ = .00016	σ_μ = .00181 σ_λ = .00019	σ_μ = .00180 σ_λ = .00014	σ_μ = .00184 σ_λ = .00008	σ_μ = .00182 σ_λ = .00012	σ_μ = .00181 σ_λ = .00015	σ_μ = .00180 σ_λ = .00015
MOON RADIUS	σ_μ = .00065 σ_λ = .00649	σ_μ = .00426 σ_λ = .00105	σ_μ = .00462 σ_λ = .00636	σ_μ = .00549 σ_λ = .01660	σ_μ = .00084 σ_λ = .01590	σ_μ = .00848 σ_λ = .01557	σ_μ = .00617 σ_λ = .00673	σ_μ = .00459 σ_λ = .00029	σ_μ = .00054 σ_λ = .00644

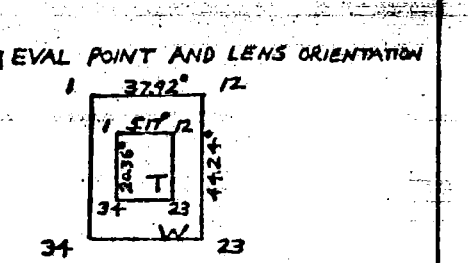
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 52





S/C ALTITUDE = 96.6 KM
TRUE ANOMALY = 1.7°
INCLINATION ≈ 85°
NOTE: APOLLO TCT V-21
R(93°) Y(-17°) P(-69°)



TELEPHOTO LENS, T

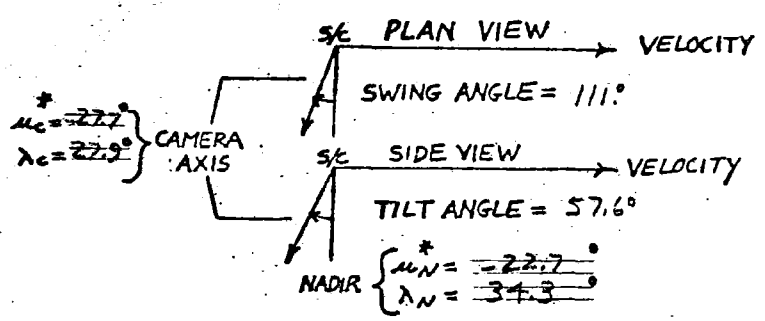
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .01770° .535 KM σ_λ = .11108° 3.36 KM	σ_μ = .02615° .791 KM σ_λ = .23672° 7.18 KM	σ_μ = .01943° .589 KM σ_λ = .11689° 3.54 KM	σ_μ = .01667° .505 KM σ_λ = .07048° 2.14 KM	σ_μ = .01617° .490 KM σ_λ = .07047° 2.14 KM	σ_μ = .01597° .484 KM σ_λ = .07052° 2.14 KM	σ_μ = .01717° .520 KM σ_λ = .10586° 3.20 KM	σ_μ = .02090° .633 KM σ_λ = .23939° 7.24 KM	σ_μ = .02123° .642 KM σ_λ = .23790° 7.20 KM
NAVIGATION	σ_μ = .01144 σ_λ = .00806	σ_μ = .01071 σ_λ = .01323	σ_μ = .01099 σ_λ = .00826	σ_μ = .01116 σ_λ = .00550	σ_μ = .01146 σ_λ = .00556	σ_μ = .01183 σ_λ = .00562	σ_μ = .01187 σ_λ = .00787	σ_μ = .01200 σ_λ = .01776	σ_μ = .01140 σ_λ = .01350
ATTITUDE	σ_μ = .01339 σ_λ = .10913	σ_μ = .02371 σ_λ = .23416	σ_μ = .01587 σ_λ = .11491	σ_μ = .01222 σ_λ = .06710	σ_μ = .01126 σ_λ = .06910	σ_μ = .01054 σ_λ = .06713	σ_μ = .01223 σ_λ = .10396	σ_μ = .01696 σ_λ = .23677	σ_μ = .01781 σ_λ = .23531
CAMERA ON-TIME	σ_μ = .00180 σ_λ = .00014	σ_μ = .00180 σ_λ = .00012	σ_μ = .00180 σ_λ = .00013	σ_μ = .00180 σ_λ = .00014	σ_μ = .00180 σ_λ = .00014	σ_μ = .00180 σ_λ = .00015	σ_μ = .00180 σ_λ = .00015	σ_μ = .00180 σ_λ = .00017	σ_μ = .00180 σ_λ = .00015
MOON RADIUS	σ_μ = .00007 σ_λ = .01907	σ_μ = .00193 σ_λ = .03212	σ_μ = .00121 σ_λ = .01977	σ_μ = .00077 σ_λ = .01264	σ_μ = .00005 σ_λ = .01269	σ_μ = .00074 σ_λ = .01275	σ_μ = .00102 σ_λ = .01843	σ_μ = .00131 σ_λ = .03254	σ_μ = .00017 σ_λ = .03232

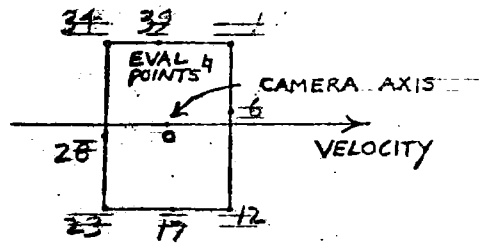
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .01802° .546 KM σ_λ = .11505° 3.48 KM	σ_μ = ND° KM σ_λ = ND° KM	σ_μ = .04834° 1.46 KM σ_λ = .13153° 3.98 KM	σ_μ = .02005° .608 KM σ_λ = .05226° 1.58 KM	σ_μ = .01557° .471 KM σ_λ = .05172° 1.57 KM	σ_μ = .01824° .553 KM σ_λ = .05185° 1.57 KM	σ_μ = .03235° .978 KM σ_λ = .10671° 3.23 KM	σ_μ = ND° KM σ_λ = ND° KM	σ_μ = ND° KM σ_λ = ND° KM
NAVIGATION	σ_μ = .01144 σ_λ = .00806	σ_μ = σ_λ =	σ_μ = .00821 σ_λ = .00804	σ_μ = .00964 σ_λ = .00354	σ_μ = .01137 σ_λ = .00372	σ_μ = .01369 σ_λ = .00402	σ_μ = .01492 σ_λ = .00838	σ_μ = σ_λ =	σ_μ = σ_λ =
ATTITUDE	σ_μ = .01381 σ_λ = .11317	σ_μ = σ_λ =	σ_μ = .04676 σ_λ = .12966	σ_μ = .01678 σ_λ = .05157	σ_μ = .01049 σ_λ = .05098	σ_μ = .01058 σ_λ = .05103	σ_μ = .02745 σ_λ = .10476	σ_μ = σ_λ =	σ_μ = σ_λ =
CAMERA ON-TIME	σ_μ = .00180 σ_λ = .00014	σ_μ = σ_λ =	σ_μ = .00184 σ_λ = .00005	σ_μ = .00181 σ_λ = .00012	σ_μ = .00180 σ_λ = .00014	σ_μ = .00181 σ_λ = .00017	σ_μ = .00183 σ_λ = .00022	σ_μ = σ_λ =	σ_μ = σ_λ =
MOON RADIUS	σ_μ = .00007 σ_λ = .01907	σ_μ = σ_λ =	σ_μ = .00894 σ_λ = .02056	σ_μ = .00490 σ_λ = .00772	σ_μ = .00024 σ_λ = .00790	σ_μ = .00546 σ_λ = .00825	σ_μ = .00819 σ_λ = .01850	σ_μ = σ_λ =	σ_μ = σ_λ =

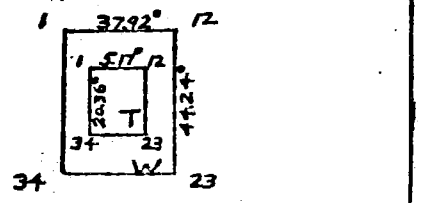
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 54





S/C ALTITUDE = 130.9 KM
TRUE ANOMALY = 336. °
INCLINATION ≈ 85. °
NOTE: R(63°) Y(-34°) P(-71°)



TELEPHOTO LENS, T

ERROR SOURCE	CAMERA AXIS (O)		EVAL POINT 1		EVAL POINT 6		EVAL POINT 12		EVAL POINT 17		EVAL POINT 23		EVAL POINT 28		EVAL POINT 34		EVAL POINT 39	
TOTAL	$\nabla\mu$ = .05162° 1.56 KM	$\nabla\lambda$ = .14484° 4.40 KM	$\nabla\mu$ = .05154° 1.56 KM	$\nabla\lambda$ = .18864° 5.73 KM	$\nabla\mu$ = .04818° 1.46 KM	$\nabla\lambda$ = .13027° 3.95 KM	$\nabla\mu$ = .04698° 1.42 KM	$\nabla\lambda$ = .10032° 3.03 KM	$\nabla\mu$ = .05091° 1.54 KM	$\nabla\lambda$ = .10905° 3.31 KM	$\nabla\mu$ = .05740° 1.74 KM	$\nabla\lambda$ = .12251° 3.73 KM	$\nabla\mu$ = .05741° 1.74 KM	$\nabla\lambda$ = .16431° 4.97 KM	$\nabla\mu$ = .06262° 1.90 KM	$\nabla\lambda$ = .31525° 9.55 KM	$\nabla\mu$ = .05936° 1.65 KM	$\nabla\lambda$ = .23956° 7.30 KM
NAVIGATION	$\nabla\mu$ = 0	$\nabla\lambda$ = 0	$\nabla\mu$ = 0	$\nabla\lambda$ = 0	$\nabla\mu$ = 0	$\nabla\lambda$ = 0	$\nabla\mu$ = 0	$\nabla\lambda$ = 0	$\nabla\mu$ = 0	$\nabla\lambda$ = 0	$\nabla\mu$ = 0	$\nabla\lambda$ = 0	$\nabla\mu$ = 0	$\nabla\lambda$ = 0	$\nabla\mu$ = 0	$\nabla\lambda$ = 0	$\nabla\mu$ = 0	$\nabla\lambda$ = 0
ATTITUDE	$\nabla\mu$ = .04832	$\nabla\lambda$ = .14277	$\nabla\mu$ = .04944	$\nabla\lambda$ = .18897	$\nabla\mu$ = .04564	$\nabla\lambda$ = .12839	$\nabla\mu$ = .04399	$\nabla\lambda$ = .09926	$\nabla\mu$ = .04741	$\nabla\lambda$ = .10785	$\nabla\mu$ = .05314	$\nabla\lambda$ = .12109	$\nabla\mu$ = .05319	$\nabla\lambda$ = .16200	$\nabla\mu$ = .05826	$\nabla\lambda$ = .31163	$\nabla\mu$ = .05122	$\nabla\lambda$ = .23647
CAMERA ON-TIME	$\nabla\mu$ = .00219	$\nabla\lambda$ = .00087	$\nabla\mu$ = .00207	$\nabla\lambda$ = .00101	$\nabla\mu$ = .00210	$\nabla\lambda$ = .00077	$\nabla\mu$ = .00213	$\nabla\lambda$ = .00057	$\nabla\mu$ = .00220	$\nabla\lambda$ = .00064	$\nabla\mu$ = .00232	$\nabla\lambda$ = .00074	$\nabla\mu$ = .00232	$\nabla\lambda$ = .00101	$\nabla\mu$ = .00237	$\nabla\lambda$ = .00167	$\nabla\mu$ = .00220	$\nabla\lambda$ = .00128
MOON RADIUS	$\nabla\mu$ = .01801	$\nabla\lambda$ = .02437	$\nabla\mu$ = .01443	$\nabla\lambda$ = .03160	$\nabla\mu$ = .01530	$\nabla\lambda$ = .02209	$\nabla\mu$ = .01636	$\nabla\lambda$ = .01455	$\nabla\mu$ = .01844	$\nabla\lambda$ = .01613	$\nabla\mu$ = .02157	$\nabla\lambda$ = .01860	$\nabla\mu$ = .02148	$\nabla\lambda$ = .02745	$\nabla\mu$ = .02282	$\nabla\lambda$ = .04766	$\nabla\mu$ = .01809	$\nabla\lambda$ = .03835

WIDE-ANGLE LENS, W

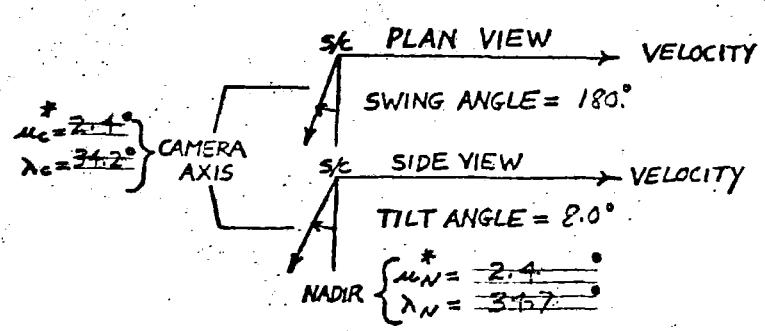
ERROR SOURCE	CAMERA AXIS		EVAL POINT 1		EVAL POINT 6		EVAL POINT 12		EVAL POINT 17		EVAL POINT 23		EVAL POINT 28		EVAL POINT 34		EVAL POINT 39	
TOTAL	$\nabla\mu$ = .05369° 1.63 KM	$\nabla\lambda$ = .14864° 4.51 KM	$\nabla\mu$ = .06681° 2.02 KM	$\nabla\lambda$ = .13034° 3.95 KM	$\nabla\mu$ = .04117° 1.24 KM	$\nabla\lambda$ = .07741° 2.35 KM	$\nabla\mu$ = .03239° .980 KM	$\nabla\lambda$ = .06598° 2.00 KM	$\nabla\mu$ = .05193° 1.57 KM	$\nabla\lambda$ = .09316° 2.83 KM	$\nabla\mu$ = ND° KM	$\nabla\lambda$ = ND° KM	$\nabla\mu$ = ND° KM	$\nabla\lambda$ = ND° KM	$\nabla\mu$ = ND° KM	$\nabla\lambda$ = ND° KM	$\nabla\mu$ = ND° KM	$\nabla\lambda$ = ND° KM
NAVIGATION	$\nabla\mu$ = 0	$\nabla\lambda$ = 0	$\nabla\mu$ = 0	$\nabla\lambda$ = 0	$\nabla\mu$ = 0	$\nabla\lambda$ = 0	$\nabla\mu$ = 0	$\nabla\lambda$ = 0	$\nabla\mu$ = 0	$\nabla\lambda$ = 0	$\nabla\mu$ =	$\nabla\lambda$ =	$\nabla\mu$ =	$\nabla\lambda$ =	$\nabla\mu$ =	$\nabla\lambda$ =	$\nabla\mu$ =	$\nabla\lambda$ =
ATTITUDE	$\nabla\mu$ = .05053	$\nabla\lambda$ = .14663	$\nabla\mu$ = .06615	$\nabla\lambda$ = .12820	$\nabla\mu$ = .04066	$\nabla\lambda$ = .07635	$\nabla\mu$ = .03097	$\nabla\lambda$ = .06581	$\nabla\mu$ = .04859	$\nabla\lambda$ = .09278	$\nabla\mu$ =	$\nabla\lambda$ =	$\nabla\mu$ =	$\nabla\lambda$ =	$\nabla\mu$ =	$\nabla\lambda$ =	$\nabla\mu$ =	$\nabla\lambda$ =
CAMERA ON-TIME	$\nabla\mu$ = .00219	$\nabla\lambda$ = .00087	$\nabla\mu$ = .00179	$\nabla\lambda$ = .00061	$\nabla\mu$ = .00186	$\nabla\lambda$ = .00093	$\nabla\mu$ = .00192	$\nabla\lambda$ = .00028	$\nabla\mu$ = .00219	$\nabla\lambda$ = .00092	$\nabla\mu$ =	$\nabla\lambda$ =	$\nabla\mu$ =	$\nabla\lambda$ =	$\nabla\mu$ =	$\nabla\lambda$ =	$\nabla\mu$ =	$\nabla\lambda$ =
MOON RADIUS	$\nabla\mu$ = .01801	$\nabla\lambda$ = .02437	$\nabla\mu$ = .00230	$\nabla\lambda$ = .00235	$\nabla\mu$ = .00618	$\nabla\lambda$ = .01274	$\nabla\mu$ = .00928	$\nabla\lambda$ = .00475	$\nabla\mu$ = .01821	$\nabla\lambda$ = .00849	$\nabla\mu$ = ND	$\nabla\lambda$ = ND	$\nabla\mu$ = ND	$\nabla\lambda$ = ND	$\nabla\mu$ = ND	$\nabla\lambda$ = ND	$\nabla\mu$ = ND	$\nabla\lambda$ = ND

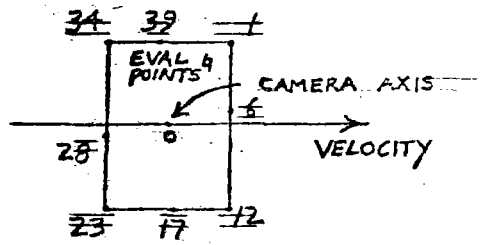
* μ = LATITUDE λ = LONGITUDE

THE BOEING COMPANY

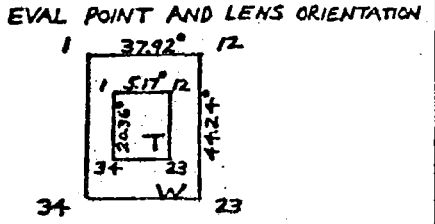
NUMBER D2 100814-3
REV LTR

ERROR ANALYSIS RESULTS MISSION V FRAME 56





S/C ALTITUDE = 96.1 KM
TRUE ANOMALY = 1.3 °
INCLINATION ≈ 85. °
NOTE: APOLLO TGT V-11A
R(30°) P(-25°) Y(-74°)
t4



TELEPHOTO LENS, T

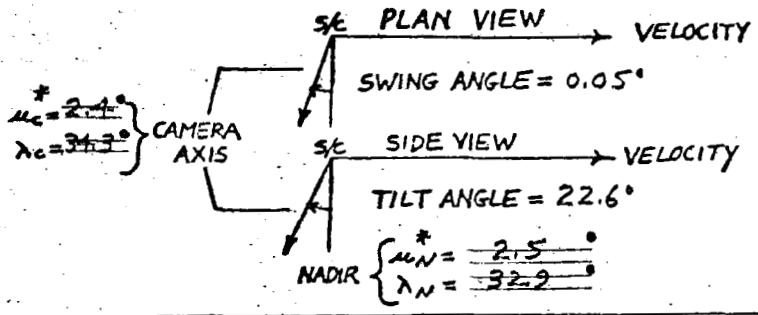
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .00648° .196 KM σ_λ = .00829° .251 KM	σ_μ = .00892° .270 KM σ_λ = .00946° .286 KM	σ_μ = .00672° .204 KM σ_λ = .00800° .242 KM	σ_μ = .00463° .140 KM σ_λ = .00767° .232 KM	σ_μ = .00462° .140 KM σ_λ = .00802° .243 KM	σ_μ = .00472° .143 KM σ_λ = .00846° .256 KM	σ_μ = .00633° .192 KM σ_λ = .00863° .261 KM	σ_μ = .00880° .267 KM σ_λ = .01021° .309 KM	σ_μ = .00882° .267 KM σ_λ = .00986° .299 KM
NAVIGATION	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0
ATTITUDE	σ_μ = .00629 σ_λ = .00806	σ_μ = .00873 σ_λ = .00831	σ_μ = .00649 σ_λ = .00771	σ_μ = .00434 σ_λ = .00765	σ_μ = .00437 σ_λ = .00800	σ_μ = .00442 σ_λ = .00345	σ_μ = .00613 σ_λ = .00844	σ_μ = .00866 σ_λ = .00910	σ_μ = .00868 σ_λ = .00873
CAMERA ON-TIME	σ_μ = .00152 σ_λ = .00012	σ_μ = .00152 σ_λ = .00012	σ_μ = .00152 σ_λ = .00012	σ_μ = .00152 σ_λ = .00013	σ_μ = .00152 σ_λ = .00013	σ_μ = .00152 σ_λ = .00013	σ_μ = .00152 σ_λ = .00012	σ_μ = .00152 σ_λ = .00012	σ_μ = .00152 σ_λ = .00012
MOON RADIUS	σ_μ = .00015 σ_λ = .00195	σ_μ = .00102 σ_λ = .00452	σ_μ = .00081 σ_λ = .00213	σ_μ = .00056 σ_λ = .00057	σ_μ = .00006 σ_λ = .00053	σ_μ = .00067 σ_λ = .00046	σ_μ = .00049 σ_λ = .00178	σ_μ = .00027 σ_λ = .00463	σ_μ = .00032 σ_λ = .00458

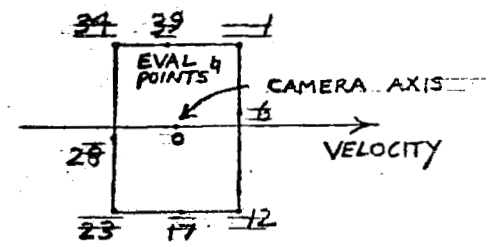
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .00715° .217 KM σ_λ = .00857° .260 KM	σ_μ = .01595° .484 KM σ_λ = .01175° .356 KM	σ_μ = .00965° .292 KM σ_λ = .00685° .208 KM	σ_μ = .00594° .180 KM σ_λ = .00803° .243 KM	σ_μ = .00378° .115 KM σ_λ = .00946° .287 KM	σ_μ = .00670° .203 KM σ_λ = .01316° .399 KM	σ_μ = .00884° .268 KM σ_λ = .01206° .366 KM	σ_μ = .01376° .417 KM σ_λ = .01685° .511 KM	σ_μ = .01306° .396 KM σ_λ = .01392° .422 KM
NAVIGATION	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0	σ_μ = 0 σ_λ = 0
ATTITUDE	σ_μ = .00698 σ_λ = .00834	σ_μ = .01474 σ_λ = .00878	σ_μ = .00807 σ_λ = .00653	σ_μ = .00385 σ_λ = .00703	σ_μ = .00346 σ_λ = .00878	σ_μ = .00433 σ_λ = .01279	σ_μ = .00734 σ_λ = .01192	σ_μ = .01290 σ_λ = .01444	σ_μ = .01297 σ_λ = .01123
CAMERA ON-TIME	σ_μ = .00152 σ_λ = .00012	σ_μ = .00154 σ_λ = .00010	σ_μ = .00154 σ_λ = .00012	σ_μ = .00153 σ_λ = .00014	σ_μ = .00152 σ_λ = .00013	σ_μ = .00153 σ_λ = .00012	σ_μ = .00153 σ_λ = .00013	σ_μ = .00153 σ_λ = .00014	σ_μ = .00152 σ_λ = .00012
MOON RADIUS	σ_μ = .00015 σ_λ = .00195	σ_μ = .00589 σ_λ = .00781	σ_μ = .00505 σ_λ = .00206	σ_μ = .00426 σ_λ = .00389	σ_μ = .00009 σ_λ = .00351	σ_μ = .00488 σ_λ = .00310	σ_μ = .00468 σ_λ = .00188	σ_μ = .00453 σ_λ = .00868	σ_μ = .00022 σ_λ = .00822

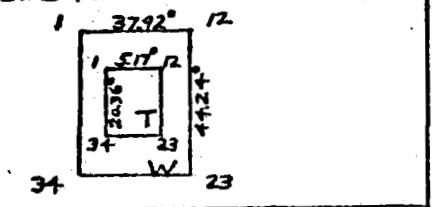
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 60





S/C ALTITUDE = 96.6 KM
TRUE ANOMALY = 1.4 °
INCLINATION ≈ 85 °
NOTE: APOLLO TGT ... =11B
t4



TELEPHOTO LENS, T

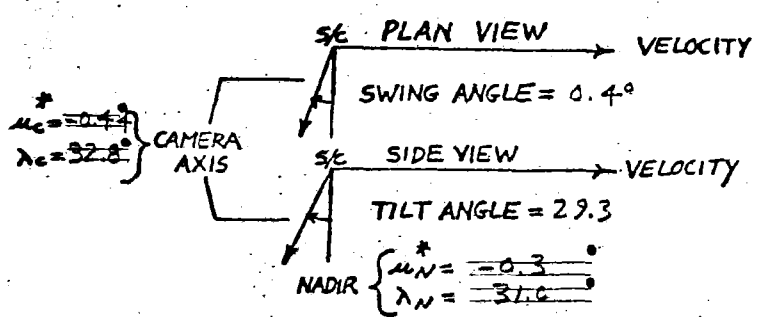
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$ = .00954° (.299 KM) $\nabla\lambda$ = .01094° (.332 KM)	$\nabla\mu$ = .01160° (.352 KM) $\nabla\lambda$ = .00821° (.249 KM)	$\nabla\mu$ = .00997° (.302 KM) $\nabla\lambda$ = .01026° (.311 KM)	$\nabla\mu$ = .00822° (.249 KM) $\nabla\lambda$ = .01430° (.434 KM)	$\nabla\mu$ = .00838° (.254 KM) $\nabla\lambda$ = .01476° (.447 KM)	$\nabla\mu$ = .00875° (.265 KM) $\nabla\lambda$ = .01537° (.465 KM)	$\nabla\mu$ = .01035° (.314 KM) $\nabla\lambda$ = .01170° (.354 KM)	$\nabla\mu$ = .01184° (.359 KM) $\nabla\lambda$ = .00899° (.272 KM)	$\nabla\mu$ = .01169° (.354 KM) $\nabla\lambda$ = .00862° (.261 KM)
NAVIGATION	$\nabla\mu$ = .00583 $\nabla\lambda$ = .00034	$\nabla\mu$ = .00582 $\nabla\lambda$ = .00038	$\nabla\mu$ = .00582 $\nabla\lambda$ = .00035	$\nabla\mu$ = .00583 $\nabla\lambda$ = .00031	$\nabla\mu$ = .00584 $\nabla\lambda$ = .00030	$\nabla\mu$ = .00585 $\nabla\lambda$ = .00029	$\nabla\mu$ = .00585 $\nabla\lambda$ = .00033	$\nabla\mu$ = .00584 $\nabla\lambda$ = .00038	$\nabla\mu$ = .00583 $\nabla\lambda$ = .00038
ATTITUDE	$\nabla\mu$ = .00770 $\nabla\lambda$ = .00928	$\nabla\mu$ = .00991 $\nabla\lambda$ = .00759	$\nabla\mu$ = .00794 $\nabla\lambda$ = .00859	$\nabla\mu$ = .00560 $\nabla\lambda$ = .01097	$\nabla\mu$ = .00530 $\nabla\lambda$ = .01162	$\nabla\mu$ = .00613 $\nabla\lambda$ = .01244	$\nabla\mu$ = .00794 $\nabla\lambda$ = .01004	$\nabla\mu$ = .01015 $\nabla\lambda$ = .00848	$\nabla\mu$ = .01001 $\nabla\lambda$ = .00806
CAMERA ON-TIME	$\nabla\mu$ = .00152 $\nabla\lambda$ = .00013	$\nabla\mu$ = .00152 $\nabla\lambda$ = .00013	$\nabla\mu$ = .00152 $\nabla\lambda$ = .00013	$\nabla\mu$ = .00152 $\nabla\lambda$ = .00014	$\nabla\mu$ = .00152 $\nabla\lambda$ = .00013	$\nabla\mu$ = .00152 $\nabla\lambda$ = .00013	$\nabla\mu$ = .00152 $\nabla\lambda$ = .00013	$\nabla\mu$ = .00152 $\nabla\lambda$ = .00013	$\nabla\mu$ = .00152 $\nabla\lambda$ = .00013
MOON RADIUS	$\nabla\mu$ = .00051 $\nabla\lambda$ = .00579	$\nabla\mu$ = .00036 $\nabla\lambda$ = .00309	$\nabla\mu$ = .00019 $\nabla\lambda$ = .00558	$\nabla\mu$ = .00006 $\nabla\lambda$ = .00915	$\nabla\mu$ = .00073 $\nabla\lambda$ = .00909	$\nabla\mu$ = .00155 $\nabla\lambda$ = .00702	$\nabla\mu$ = .00122 $\nabla\lambda$ = .00600	$\nabla\mu$ = .00096 $\nabla\lambda$ = .00298	$\nabla\mu$ = .00073 $\nabla\lambda$ = .00309

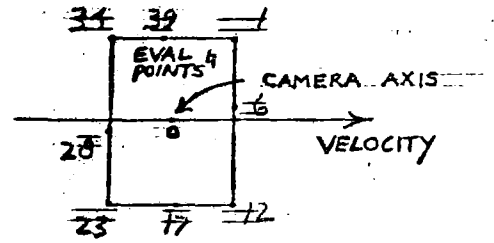
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\nabla\mu$ = .01070° (.324 KM) $\nabla\lambda$ = .01122° (.341 KM)	$\nabla\mu$ = .01637° (.495 KM) $\nabla\lambda$ = .00612° (.185 KM)	$\nabla\mu$ = .01239° (.376 KM) $\nabla\lambda$ = .00912° (.276 KM)	$\nabla\mu$ = .00962° (.291 KM) $\nabla\lambda$ = .02040° (.618 KM)	$\nabla\mu$ = .00776° (.232 KM) $\nabla\lambda$ = .02276° (.689 KM)	$\nabla\mu$ = .01483° (.449 KM) $\nabla\lambda$ = .03136° (.950 KM)	$\nabla\mu$ = .01484° (.450 KM) $\nabla\lambda$ = .01666° (.505 KM)	$\nabla\mu$ = .01704° (.517 KM) $\nabla\lambda$ = .01071° (.324 KM)	$\nabla\mu$ = .01481° (.449 KM) $\nabla\lambda$ = .00795° (.241 KM)
NAVIGATION	$\nabla\mu$ = .00583 $\nabla\lambda$ = .00034	$\nabla\mu$ = .00580 $\nabla\lambda$ = .00042	$\nabla\mu$ = .00580 $\nabla\lambda$ = .00039	$\nabla\mu$ = .00580 $\nabla\lambda$ = .00039	$\nabla\mu$ = .00584 $\nabla\lambda$ = .00026	$\nabla\mu$ = .00604 $\nabla\lambda$ = .00018	$\nabla\mu$ = .00597 $\nabla\lambda$ = .00029	$\nabla\mu$ = .00593 $\nabla\lambda$ = .00043	$\nabla\mu$ = .00583 $\nabla\lambda$ = .00042
ATTITUDE	$\nabla\mu$ = .00882 $\nabla\lambda$ = .00961	$\nabla\mu$ = .01458 $\nabla\lambda$ = .00609	$\nabla\mu$ = .00978 $\nabla\lambda$ = .00710	$\nabla\mu$ = .00533 $\nabla\lambda$ = .01357	$\nabla\mu$ = .00467 $\nabla\lambda$ = .01756	$\nabla\mu$ = .01090 $\nabla\lambda$ = .02805	$\nabla\mu$ = .01215 $\nabla\lambda$ = .01556	$\nabla\mu$ = .01527 $\nabla\lambda$ = .01070	$\nabla\mu$ = .01352 $\nabla\lambda$ = .00793
CAMERA ON-TIME	$\nabla\mu$ = .00152 $\nabla\lambda$ = .00013	$\nabla\mu$ = .00153 $\nabla\lambda$ = .00013	$\nabla\mu$ = .00154 $\nabla\lambda$ = .00014	$\nabla\mu$ = .00154 $\nabla\lambda$ = .00018	$\nabla\mu$ = .00152 $\nabla\lambda$ = .00014	$\nabla\mu$ = .00154 $\nabla\lambda$ = .00009	$\nabla\mu$ = .00153 $\nabla\lambda$ = .00011	$\nabla\mu$ = .00153 $\nabla\lambda$ = .00012	$\nabla\mu$ = .00152 $\nabla\lambda$ = .00012
MOON RADIUS	$\nabla\mu$ = .00051 $\nabla\lambda$ = .00579	$\nabla\mu$ = .00440 $\nabla\lambda$ = .00049	$\nabla\mu$ = .00467 $\nabla\lambda$ = .00571	$\nabla\mu$ = .00530 $\nabla\lambda$ = .01522	$\nabla\mu$ = .00071 $\nabla\lambda$ = .01449	$\nabla\mu$ = .00190 $\nabla\lambda$ = .01402	$\nabla\mu$ = .00587 $\nabla\lambda$ = .00597	$\nabla\mu$ = .00443 $\nabla\lambda$ = .00027	$\nabla\mu$ = .00040 $\nabla\lambda$ = .00007

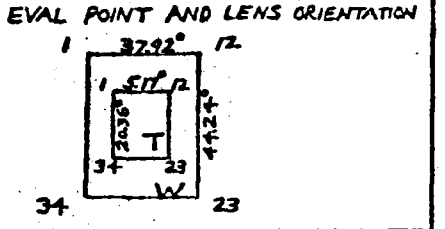
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 63





S/C ALTITUDE = 95.9 KM
TRUE ANOMALY = 359.
INCLINATION ≈ 85.
NOTE: P(27°) P(10°) P(-87°)



TELEPHOTO LENS, T

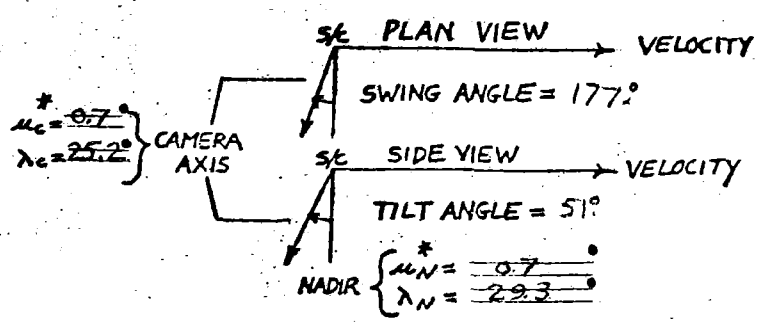
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.01300° .395 KM σ_λ=.01335° .405 KM	σ_u=.01429° .435 KM σ_λ=.00967° .293 KM	σ_u=.01296° .394 KM σ_λ=.01251° .380 KM	σ_u=.01158° .351 KM σ_λ=.01806° .550 KM	σ_u=.01177° .357 KM σ_λ=.01863° .563 KM	σ_u=.01214° .367 KM σ_λ=.01942° .580 KM	σ_u=.01315° .400 KM σ_λ=.01428° .435 KM	σ_u=.01459° .442 KM σ_λ=.01050° .318 KM	σ_u=.01492° .437 KM σ_λ=.01010° .306 KM
NAVIGATION	σ_u=.00992 σ_λ=.00057	σ_u=.00989 σ_λ=.00066	σ_u=.00990 σ_λ=.00059	σ_u=.00990 σ_λ=.00049	σ_u=.00992 σ_λ=.00047	σ_u=.00995 σ_λ=.00044	σ_u=.00994 σ_λ=.00059	σ_u=.00993 σ_λ=.00063	σ_u=.00991 σ_λ=.00065
ATTITUDE	σ_u=.00818 σ_λ=.01076	σ_u=.01016 σ_λ=.00832	σ_u=.00817 σ_λ=.00989	σ_u=.00573 σ_λ=.01359	σ_u=.00604 σ_λ=.01440	σ_u=.00647 σ_λ=.01545	σ_u=.00830 σ_λ=.01173	σ_u=.01049 σ_λ=.00993	σ_u=.01030 σ_λ=.00885
CAMERA ON-TIME	σ_u=.00180 σ_λ=.00014	σ_u=.00180 σ_λ=.00014	σ_u=.00180 σ_λ=.00014	σ_u=.00180 σ_λ=.00014	σ_u=.00180 σ_λ=.00014	σ_u=.00184 σ_λ=.00013	σ_u=.00182 σ_λ=.00014	σ_u=.00180 σ_λ=.00014	σ_u=.00180 σ_λ=.00014
MOON RADIUS	σ_u=.00068 σ_λ=.00788	σ_u=.00022 σ_λ=.00987	σ_u=.00006 σ_λ=.00763	σ_u=.00017 σ_λ=.01188	σ_u=.00092 σ_λ=.01182	σ_u=.00182 σ_λ=.01175	σ_u=.00144 σ_λ=.00814	σ_u=.00109 σ_λ=.00977	σ_u=.00049 σ_λ=.00981

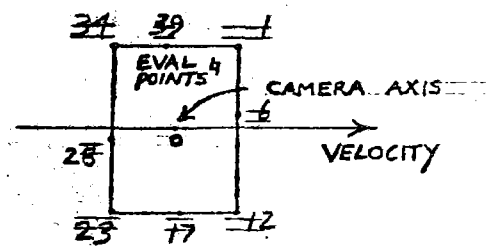
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u=.01361° .414 KM σ_λ=.01366° .414 KM	σ_u=.01829° .555 KM σ_λ=.00667° .202 KM	σ_u=.01500° .455 KM σ_λ=.01121° .340 KM	σ_u=.01345° .406 KM σ_λ=.02755° .839 KM	σ_u=.01135° .344 KM σ_λ=.03107° .950 KM	σ_u=.02051° .623 KM σ_λ=.04424° 1.34 KM	σ_u=.01834° .555 KM σ_λ=.02031° .615 KM	σ_u=.01954° .591 KM σ_λ=.01140° .346 KM	σ_u=.01706° .519 KM σ_λ=.00896° .256 KM
NAVIGATION	σ_u=.00992 σ_λ=.00057	σ_u=.00984 σ_λ=.00076	σ_u=.00984 σ_λ=.00070	σ_u=.00986 σ_λ=.00070	σ_u=.00992 σ_λ=.00033	σ_u=.01039 σ_λ=.00031	σ_u=.01019 σ_λ=.00092	σ_u=.01009 σ_λ=.00073	σ_u=.00991 σ_λ=.00074
ATTITUDE	σ_u=.00912 σ_λ=.01115	σ_u=.01470 σ_λ=.00628	σ_u=.01009 σ_λ=.00811	σ_u=.00694 σ_λ=.01903	σ_u=.00514 σ_λ=.02455	σ_u=.01483 σ_λ=.04006	σ_u=.01369 σ_λ=.01858	σ_u=.01597 σ_λ=.01129	σ_u=.01776 σ_λ=.00825
CAMERA ON-TIME	σ_u=.00180 σ_λ=.00014	σ_u=.00180 σ_λ=.00015	σ_u=.00181 σ_λ=.00016	σ_u=.00182 σ_λ=.00021	σ_u=.00180 σ_λ=.00014	σ_u=.00184 σ_λ=.00005	σ_u=.00182 σ_λ=.00011	σ_u=.00181 σ_λ=.00014	σ_u=.00180 σ_λ=.00014
MOON RADIUS	σ_u=.00068 σ_λ=.00788	σ_u=.00426 σ_λ=.00210	σ_u=.00481 σ_λ=.00771	σ_u=.00624 σ_λ=.01891	σ_u=.00089 σ_λ=.01905	σ_u=.00946 σ_λ=.01877	σ_u=.00696 σ_λ=.00821	σ_u=.00965 σ_λ=.00140	σ_u=.00058 σ_λ=.00171

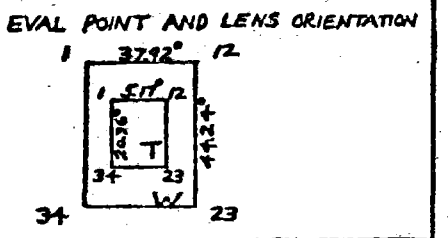
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 64





S/C ALTITUDE = 957 KM
TRUE ANOMALY = 359 °
INCLINATION ≈ 65 °
NOTE: APOLLO TGT. V-13
R(94°) Y(-18°) P(-68°)



TELEPHOTO LENS, T

ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .01937° .586 KM; σ_λ = .10540° 3.20 KM	σ_μ = .02709° .820 KM; σ_λ = .21889° 6.63 KM	σ_μ = .02092° .633 KM; σ_λ = .11056° 3.35 KM	σ_μ = .01847° .559 KM; σ_λ = .06738° 2.04 KM	σ_μ = .01803° .546 KM; σ_λ = .06748° 2.04 KM	σ_μ = .01783° .540 KM; σ_λ = .06763° 2.05 KM	σ_μ = .01881° .570 KM; σ_λ = .10074° 3.04 KM	σ_μ = .02176° .657 KM; σ_λ = .22254° 6.75 KM	σ_μ = .02255° .682 KM; σ_λ = .22063° 6.69 KM
NAVIGATION	σ_μ = .01407; σ_λ = .00580	σ_μ = .01358; σ_λ = .00903	σ_μ = .01378; σ_λ = .00589	σ_μ = .01390; σ_λ = .00409	σ_μ = .01409; σ_λ = .00415	σ_μ = .01434; σ_λ = .00422	σ_μ = .01436; σ_λ = .00572	σ_μ = .01443; σ_λ = .00959	σ_μ = .01403; σ_λ = .00932
ATTITUDE	σ_μ = .01319; σ_λ = .10357	σ_μ = .02330; σ_λ = .21649	σ_μ = .01561; σ_λ = .10870	σ_μ = .01202; σ_λ = .06610	σ_μ = .01110; σ_λ = .06619	σ_μ = .01038; σ_λ = .06632	σ_μ = .01196; σ_λ = .09894	σ_μ = .01614; σ_λ = .22008	σ_μ = .01756; σ_λ = .21820
CAMERA ON-TIME	σ_μ = .00180; σ_λ = .00016	σ_μ = .00180; σ_λ = .00016	σ_μ = .00180; σ_λ = .00015	σ_μ = .00180; σ_λ = .00015	σ_μ = .00180; σ_λ = .00015	σ_μ = .00180; σ_λ = .00016	σ_μ = .00180; σ_λ = .00017	σ_μ = .00180; σ_λ = .00021	σ_μ = .00180; σ_λ = .00019
MOON RADIUS	σ_μ = .00002; σ_λ = .01868	σ_μ = .00185; σ_λ = .03104	σ_μ = .00111; σ_λ = .01933	σ_μ = .00066; σ_λ = .01140	σ_μ = .00011; σ_λ = .01246	σ_μ = .00104; σ_λ = .01253	σ_μ = .00110; σ_λ = .01807	σ_μ = .00130; σ_λ = .03155	σ_μ = .00015; σ_λ = .03129

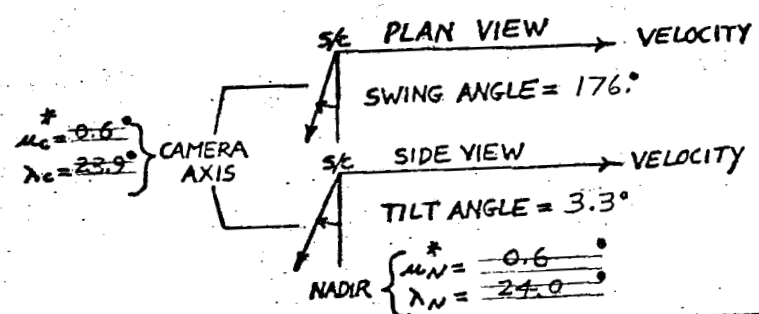
WIDE-ANGLE LENS, W

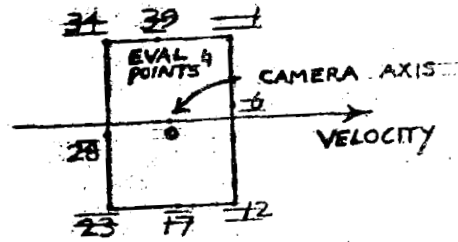
ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .01967° .595 KM; σ_λ = .10921° 3.32 KM	σ_μ = ND° KM; σ_λ = ND° KM	σ_μ = .04675° 1.42 KM; σ_λ = .12255° 3.72 KM	σ_μ = .02135° .647 KM; σ_λ = .04998° 1.51 KM	σ_μ = .01752° .532 KM; σ_λ = .04983° 1.51 KM	σ_μ = .01969° .596 KM; σ_λ = .05040° 1.53 KM	σ_μ = .03195° .967 KM; σ_λ = .10283° 3.12 KM	σ_μ = ND° KM; σ_λ = ND° KM	σ_μ = ND° KM; σ_λ = ND° KM
NAVIGATION	σ_μ = .01407; σ_λ = .00560	σ_μ =; σ_λ =	σ_μ = .01207; σ_λ = .00542	σ_μ = .01293; σ_λ = .00272	σ_μ = .01403; σ_λ = .00292	σ_μ = .01565; σ_λ = .00322	σ_μ = .01653; σ_λ = .00634	σ_μ =; σ_λ =	σ_μ =; σ_λ =
ATTITUDE	σ_μ = .01363; σ_λ = .10744	σ_μ =; σ_λ =	σ_μ = .04428; σ_λ = .12080	σ_μ = .01621; σ_λ = .04933	σ_μ = .01034; σ_λ = .04914	σ_μ = .01041; σ_λ = .04964	σ_μ = .02601; σ_λ = .10099	σ_μ =; σ_λ =	σ_μ =; σ_λ =
CAMERA ON-TIME	σ_μ = .00180; σ_λ = .00016	σ_μ =; σ_λ =	σ_μ = .00183; σ_λ = .00007	σ_μ = .00181; σ_λ = .00013	σ_μ = .00180; σ_λ = .00015	σ_μ = .00182; σ_λ = .00017	σ_μ = .00184; σ_λ = .00024	σ_μ =; σ_λ =	σ_μ =; σ_λ =
MOON RADIUS	σ_μ = .00002; σ_λ = .01868	σ_μ =; σ_λ =	σ_μ = .00867; σ_λ = .01992	σ_μ = .00473; σ_λ = .00753	σ_μ = .00012; σ_λ = .00774	σ_μ = .00557; σ_λ = .00814	σ_μ = .00822; σ_λ = .01828	σ_μ =; σ_λ =	σ_μ =; σ_λ =

* μ = LATITUDE λ = LONGITUDE

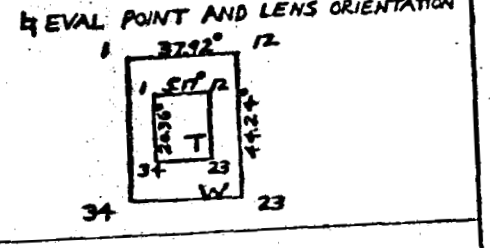
THE BOEING COMPANY

ERROR ANALYSIS RESULTS MISSION V FRAME 72





S/C ALTITUDE = 95.7 KM
TRUE ANOMALY = 359. °
INCLINATION = 85. °
NOTE: APOLLO TGT. V-16A
R(30°) P(-20°) Y(-76°)



TELEPHOTO LENS, T

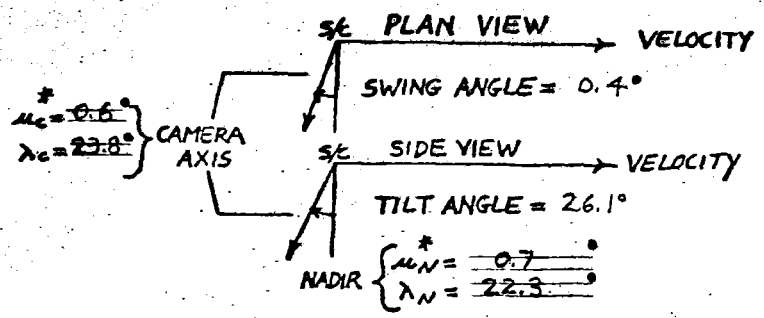
ERROR SOURCE	CAMERA AXIS(O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .01168° (.354 KM) $\nabla\lambda$ = .00789° (.239 KM)	∇u = .01310° (.397 KM) $\nabla\lambda$ = .00848° (.257 KM)	∇u = .01175° (.356 KM) $\nabla\lambda$ = .00753° (.228 KM)	∇u = .01068° (.323 KM) $\nabla\lambda$ = .00786° (.238 KM)	∇u = .01072° (.324 KM) $\nabla\lambda$ = .00821° (.249 KM)	∇u = .01086° (.329 KM) $\nabla\lambda$ = .00866° (.262 KM)	∇u = .01168° (.354 KM) $\nabla\lambda$ = .00827° (.251 KM)	∇u = .01316° (.399 KM) $\nabla\lambda$ = .00923° (.280 KM)	∇u = .01311° (.398 KM) $\nabla\lambda$ = .00888° (.269 KM)
NAVIGATION	∇u = .00749 $\nabla\lambda$ = .00082	∇u = .00739 $\nabla\lambda$ = .00102	∇u = .00941 $\nabla\lambda$ = .00083	∇u = .00944 $\nabla\lambda$ = .00068	∇u = .00950 $\nabla\lambda$ = .00068	∇u = .00958 $\nabla\lambda$ = .00068	∇u = .00956 $\nabla\lambda$ = .00081	∇u = .00954 $\nabla\lambda$ = .00104	∇u = .00947 $\nabla\lambda$ = .00103
ATTITUDE	∇u = .00658 $\nabla\lambda$ = .00780	∇u = .00891 $\nabla\lambda$ = .00776	∇u = .00676 $\nabla\lambda$ = .00742	∇u = .00459 $\nabla\lambda$ = .00764	∇u = .00464 $\nabla\lambda$ = .00801	∇u = .00471 $\nabla\lambda$ = .00848	∇u = .00644 $\nabla\lambda$ = .00822	∇u = .00888 $\nabla\lambda$ = .00853	∇u = .00888 $\nabla\lambda$ = .00817
CAMERA ON-TIME	∇u = .00180 $\nabla\lambda$ = .00014	∇u = .00180 $\nabla\lambda$ = .00014	∇u = .00180 $\nabla\lambda$ = .00014	∇u = .00180 $\nabla\lambda$ = .00014	∇u = .00180 $\nabla\lambda$ = .00014	∇u = .00180 $\nabla\lambda$ = .00014	∇u = .00180 $\nabla\lambda$ = .00014	∇u = .00180 $\nabla\lambda$ = .00014	∇u = .00180 $\nabla\lambda$ = .00014
MOON RADIUS	∇u = .00001 $\nabla\lambda$ = .00080	∇u = .00085 $\nabla\lambda$ = .00327	∇u = .00066 $\nabla\lambda$ = .00097	∇u = .00043 $\nabla\lambda$ = .00172	∇u = .00013 $\nabla\lambda$ = .00167	∇u = .00081 $\nabla\lambda$ = .00162	∇u = .00063 $\nabla\lambda$ = .00062	∇u = .00041 $\nabla\lambda$ = .00337	∇u = .00016 $\nabla\lambda$ = .00332

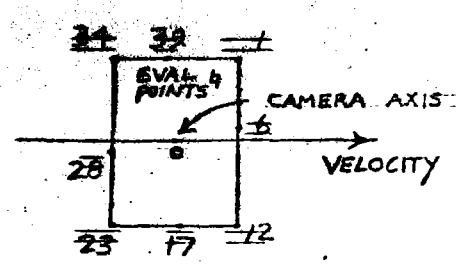
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 32
TOTAL	∇u = .01212° (.368 KM) $\nabla\lambda$ = .00817° (.248 KM)	∇u = .01803° (.546 KM) $\nabla\lambda$ = .01006° (.304 KM)	∇u = .01335° (.404 KM) $\nabla\lambda$ = .00631° (.191 KM)	∇u = .01091° (.331 KM) $\nabla\lambda$ = .00884° (.268 KM)	∇u = .01031° (.313 KM) $\nabla\lambda$ = .01033° (.314 KM)	∇u = .01252° (.380 KM) $\nabla\lambda$ = .01432° (.435 KM)	∇u = .01387° (.420 KM) $\nabla\lambda$ = .01188° (.360 KM)	∇u = .01729° (.523 KM) $\nabla\lambda$ = .01487° (.450 KM)	∇u = .01615° (.490 KM) $\nabla\lambda$ = .01213° (.368 KM)
NAVIGATION	∇u = .00949 $\nabla\lambda$ = .00082	∇u = .00894 $\nabla\lambda$ = .00123	∇u = .00900 $\nabla\lambda$ = .00082	∇u = .00905 $\nabla\lambda$ = .00066	∇u = .00949 $\nabla\lambda$ = .00067	∇u = .01015 $\nabla\lambda$ = .00067	∇u = .01011 $\nabla\lambda$ = .00082	∇u = .01006 $\nabla\lambda$ = .00149	∇u = .00948 $\nabla\lambda$ = .00136
ATTITUDE	∇u = .00732 $\nabla\lambda$ = .00809	∇u = .01456 $\nabla\lambda$ = .00776	∇u = .00840 $\nabla\lambda$ = .00619	∇u = .00396 $\nabla\lambda$ = .00715	∇u = .00360 $\nabla\lambda$ = .00914	∇u = .00488 $\nabla\lambda$ = .01362	∇u = .00800 $\nabla\lambda$ = .01183	∇u = .01321 $\nabla\lambda$ = .01299	∇u = .01295 $\nabla\lambda$ = .01004
CAMERA ON-TIME	∇u = .00180 $\nabla\lambda$ = .00014	∇u = .00181 $\nabla\lambda$ = .00013	∇u = .00181 $\nabla\lambda$ = .00014	∇u = .00181 $\nabla\lambda$ = .00015	∇u = .00150 $\nabla\lambda$ = .00014	∇u = .00181 $\nabla\lambda$ = .00013	∇u = .00181 $\nabla\lambda$ = .00014	∇u = .00181 $\nabla\lambda$ = .00016	∇u = .00180 $\nabla\lambda$ = .00015
MOON RADIUS	∇u = .00001 $\nabla\lambda$ = .00080	∇u = .00544 $\nabla\lambda$ = .00628	∇u = .00484 $\nabla\lambda$ = .00090	∇u = .00425 $\nabla\lambda$ = .00514	∇u = .00603 $\nabla\lambda$ = .00476	∇u = .00514 $\nabla\lambda$ = .00438	∇u = .00480 $\nabla\lambda$ = .00070	∇u = .00447 $\nabla\lambda$ = .00710	∇u = .00006 $\nabla\lambda$ = .00667

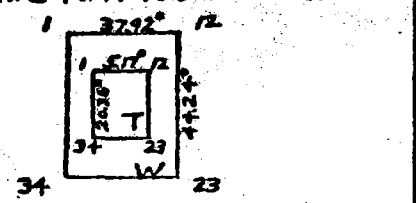
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 76





S/C ALTITUDE = 95.7 KM
TRUE ANOMALY = 359.°
INCLINATION = 85.°
NOTE: APOLLO TGT. V-16B



TELEPHOTO LENS, T

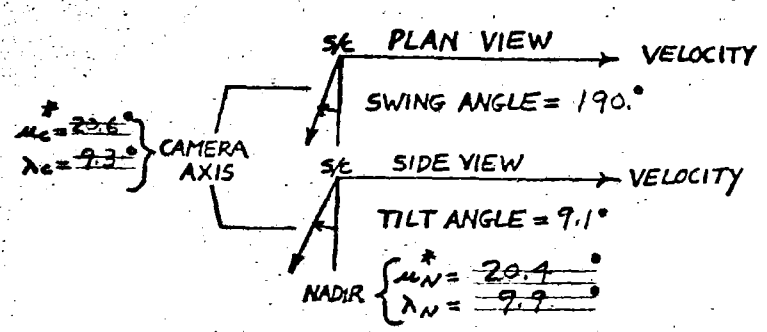
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .01870° .566 KM σ_λ = .01211° .367 KM	σ_μ = .01956° .592 KM σ_λ = .00893° .270 KM	σ_μ = .01863° .565 KM σ_λ = .01135° .344 KM	σ_μ = .01774° .537 KM σ_λ = .01609° .486 KM	σ_μ = .01791° .543 KM σ_λ = .01660° .503 KM	σ_μ = .01819° .550 KM σ_λ = .01730° .525 KM	σ_μ = .01884° .570 KM σ_λ = .01296° .392 KM	σ_μ = .01984° .601 KM σ_λ = .00974° .295 KM	σ_μ = .01969° .595 KM σ_λ = .00935° .283 KM
NAVIGATION	σ_μ = .01676 σ_λ = .00060	σ_μ = .01667 σ_λ = .00085	σ_μ = .01669 σ_λ = .00064	σ_μ = .01671 σ_λ = .00046	σ_μ = .01677 σ_λ = .00046	σ_μ = .01688 σ_λ = .00046	σ_μ = .01684 σ_λ = .00057	σ_μ = .01681 σ_λ = .00083	σ_μ = .01674 σ_λ = .00084
ATTITUDE	σ_μ = .00306 σ_λ = .00978	σ_μ = .01007 σ_λ = .00793	σ_μ = .00859 σ_λ = .00920	σ_μ = .00567 σ_λ = .01219	σ_μ = .00571 σ_λ = .01291	σ_μ = .00630 σ_λ = .01384	σ_μ = .00814 σ_λ = .01084	σ_μ = .01034 σ_λ = .00889	σ_μ = .01019 σ_λ = .00844
CAMERA ON-TIME	σ_μ = .00180 σ_λ = .00014	σ_μ = .00180 σ_λ = .00014	σ_μ = .00180 σ_λ = .00014	σ_μ = .00180 σ_λ = .00014	σ_μ = .00180 σ_λ = .00014	σ_μ = .00180 σ_λ = .00013	σ_μ = .00180 σ_λ = .00014	σ_μ = .00180 σ_λ = .00014	σ_μ = .00180 σ_λ = .00014
MOON RADIUS	σ_μ = .00060 σ_λ = .00684	σ_μ = .00028 σ_λ = .00400	σ_μ = .00012 σ_λ = .00661	σ_μ = .00011 σ_λ = .01049	σ_μ = .00082 σ_λ = .01043	σ_μ = .00167 σ_λ = .01036	σ_μ = .00133 σ_λ = .00707	σ_μ = .00100 σ_λ = .00387	σ_μ = .00042 σ_λ = .00394

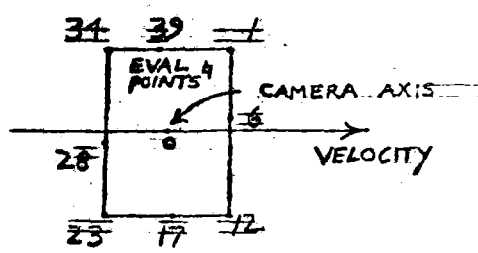
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .01912° .580 KM σ_λ = .01241° .376 KM	σ_μ = .02246° .681 KM σ_λ = .00640° .194 KM	σ_μ = .01979° .599 KM σ_λ = .01013° .307 KM	σ_μ = .01830° .555 KM σ_λ = .02359° .715 KM	σ_μ = .01758° .532 KM σ_λ = .02652° .803 KM	σ_μ = .02363° .715 KM σ_λ = .03723° 1.13 KM	σ_μ = .02271° .688 KM σ_λ = .01846° .560 KM	σ_μ = .02384° .721 KM σ_λ = .01107° .335 KM	σ_μ = .02171° .657 KM σ_λ = .00821° .249 KM
NAVIGATION	σ_μ = .01676 σ_λ = .00060	σ_μ = .01634 σ_λ = .00112	σ_μ = .01632 σ_λ = .00076	σ_μ = .01628 σ_λ = .00054	σ_μ = .01678 σ_λ = .00079	σ_μ = .01794 σ_λ = .00133	σ_μ = .01753 σ_λ = .00047	σ_μ = .01728 σ_λ = .00114	σ_μ = .01675 σ_λ = .00112
ATTITUDE	σ_μ = .00900 σ_λ = .01034	σ_μ = .01468 σ_λ = .00616	σ_μ = .00997 σ_λ = .00756	σ_μ = .00580 σ_λ = .01593	σ_μ = .00487 σ_λ = .02063	σ_μ = .01261 σ_λ = .03345	σ_μ = .01292 σ_λ = .01703	σ_μ = .01567 σ_λ = .01099	σ_μ = .01368 σ_λ = .00808
CAMERA ON-TIME	σ_μ = .00180 σ_λ = .00014	σ_μ = .00181 σ_λ = .00014	σ_μ = .00181 σ_λ = .00016	σ_μ = .00182 σ_λ = .00020	σ_μ = .00180 σ_λ = .00014	σ_μ = .00183 σ_λ = .00008	σ_μ = .00182 σ_λ = .00012	σ_μ = .00181 σ_λ = .00014	σ_μ = .00180 σ_λ = .00014
MOON RADIUS	σ_μ = .00060 σ_λ = .00684	σ_μ = .00430 σ_λ = .00131	σ_μ = .00473 σ_λ = .00670	σ_μ = .00574 σ_λ = .01739	σ_μ = .00078 σ_λ = .01663	σ_μ = .00860 σ_λ = .01628	σ_μ = .00616 σ_λ = .00711	σ_μ = .00455 σ_λ = .00060	σ_μ = .00051 σ_λ = .00092

* μ = LATITUDE λ = LONGITUDE

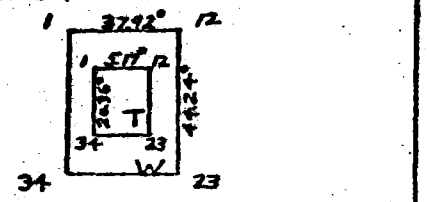
ERROR ANALYSIS RESULTS MISSION V FRAME 91





S/C ALTITUDE = ~~117.9~~ KM
TRUE ANOMALY = ~~18.6~~ °
INCLINATION ≈ ~~85.~~ °
NOTE: ~~R(12°) P(-27°) Y(-80°)~~
t4

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

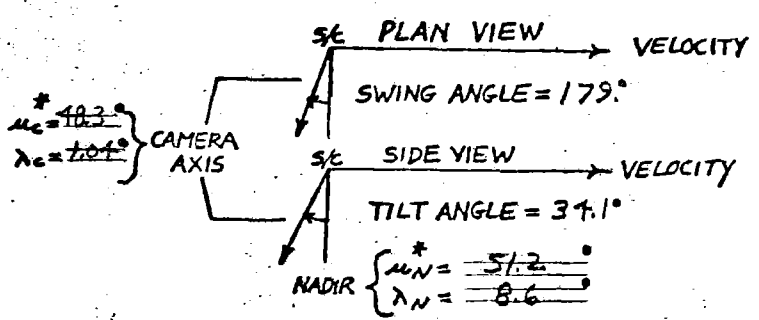
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.01106° .336 KM σ_λ=.01054° .319 KM	σ_μ=.01340° .405 KM σ_λ=.01197° .364 KM	σ_μ=.01136° .343 KM σ_λ=.01020° .310 KM	σ_μ=.00964° .293 KM σ_λ=.00970° .294 KM	σ_μ=.0096° .292 KM σ_λ=.01010° .306 KM	σ_μ=.00963° .292 KM σ_λ=.01063° .322 KM	σ_μ=.01089° .330 KM σ_λ=.01093° .330 KM	σ_μ=.01320° .400 KM σ_λ=.01285° .389 KM	σ_μ=.01327° .404 KM σ_λ=.01244° .376 KM
NAVIGATION	σ_μ=.00817 σ_λ=.00144	σ_μ=.00817 σ_λ=.00144	σ_μ=.00817 σ_λ=.00144	σ_μ=.00817 σ_λ=.00144	σ_μ=.00818 σ_λ=.00144	σ_μ=.00818 σ_λ=.00144	σ_μ=.00818 σ_λ=.00143	σ_μ=.00818 σ_λ=.00144	σ_μ=.00817 σ_λ=.00144
ATTITUDE	σ_μ=.00722 σ_λ=.01018	σ_μ=.01037 σ_λ=.01071	σ_μ=.00756 σ_λ=.00978	σ_μ=.00469 σ_λ=.00958	σ_μ=.00471 σ_λ=.01000	σ_μ=.00476 σ_λ=.01053	σ_μ=.00697 σ_λ=.01062	σ_μ=.01021 σ_λ=.01165	σ_μ=.01027 σ_λ=.01120
CAMERA ON-TIME	σ_μ=.00178 σ_λ=.00013	σ_μ=.00179 σ_λ=.00009	σ_μ=.00179 σ_λ=.00013	σ_μ=.00178 σ_λ=.00016	σ_μ=.00178 σ_λ=.00016	σ_μ=.00177 σ_λ=.00016	σ_μ=.00177 σ_λ=.00013	σ_μ=.00178 σ_λ=.00010	σ_μ=.00178 σ_λ=.00010
MOON RADIUS	σ_μ=.00056 σ_λ=.00233	σ_μ=.00142 σ_λ=.00516	σ_μ=.00122 σ_λ=.00253	σ_μ=.00099 σ_λ=.00040	σ_μ=.00092 σ_λ=.00035	σ_μ=.00026 σ_λ=.00029	σ_μ=.00009 σ_λ=.00213	σ_μ=.00009 σ_λ=.00529	σ_μ=.00069 σ_λ=.00520

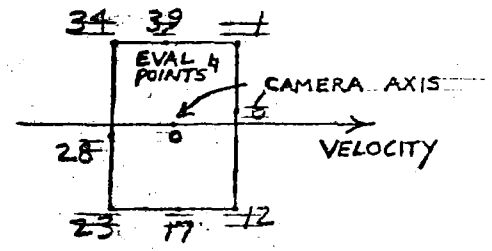
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ=.01164° .352 KM σ_λ=.01083° .327 KM	σ_μ=.02118° .642 KM σ_λ=.01517° .460 KM	σ_μ=.01395° .425 KM σ_λ=.00915° .277 KM	σ_μ=.01045° .315 KM σ_λ=.01003° .303 KM	σ_μ=.00910° .276 KM σ_λ=.01152° .350 KM	σ_μ=.01055° .321 KM σ_λ=.01604° .321 KM	σ_μ=.01253° .379 KM σ_λ=.01505° .458 KM	σ_μ=.01789° .542 KM σ_λ=.02092° .633 KM	σ_μ=.01776° .537 KM σ_λ=.01743° .528 KM
NAVIGATION	σ_μ=.00817 σ_λ=.00144	σ_μ=.00823 σ_λ=.00151	σ_μ=.00820 σ_λ=.00146	σ_μ=.00819 σ_λ=.00147	σ_μ=.00818 σ_λ=.00146	σ_μ=.00830 σ_λ=.00147	σ_μ=.00829 σ_λ=.00142	σ_μ=.00828 σ_λ=.00143	σ_μ=.00817 σ_λ=.00145
ATTITUDE	σ_μ=.00807 σ_λ=.01048	σ_μ=.01833 σ_λ=.01203	σ_μ=.00961 σ_λ=.00867	σ_μ=.00900 σ_λ=.00905	σ_μ=.00355 σ_λ=.01085	σ_μ=.00943 σ_λ=.01568	σ_μ=.00817 σ_λ=.01482	σ_μ=.01516 σ_λ=.01858	σ_μ=.01566 σ_λ=.01472
CAMERA ON-TIME	σ_μ=.00178 σ_λ=.00013	σ_μ=.00186 σ_λ=.00002	σ_μ=.00184 σ_λ=.00012	σ_μ=.00183 σ_λ=.00022	σ_μ=.00178 σ_λ=.00020	σ_μ=.00175 σ_λ=.00019	σ_μ=.00175 σ_λ=.00014	σ_μ=.00175 σ_λ=.00007	σ_μ=.00178 σ_λ=.00005
MOON RADIUS	σ_μ=.00056 σ_λ=.00232	σ_μ=.00645 σ_λ=.00913	σ_μ=.00561 σ_λ=.00254	σ_μ=.00476 σ_λ=.00407	σ_μ=.00050 σ_λ=.00357	σ_μ=.00946 σ_λ=.00307	σ_μ=.00430 σ_λ=.00218	σ_μ=.00433 σ_λ=.00949	σ_μ=.00051 σ_λ=.00924

* μ = LATITUDE λ = LONGITUDE

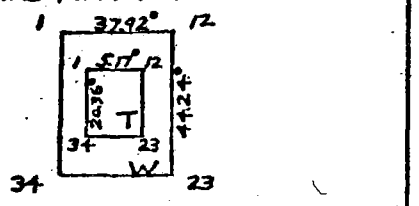
ERROR ANALYSIS RESULTS MISSION V FRAME 102





S/C ALTITUDE = 247.0 KM
TRUE ANOMALY = 49.5 °
INCLINATION ≈ 85. °
NOTE: ~~B(B4) Y(-23) P(-179)~~

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

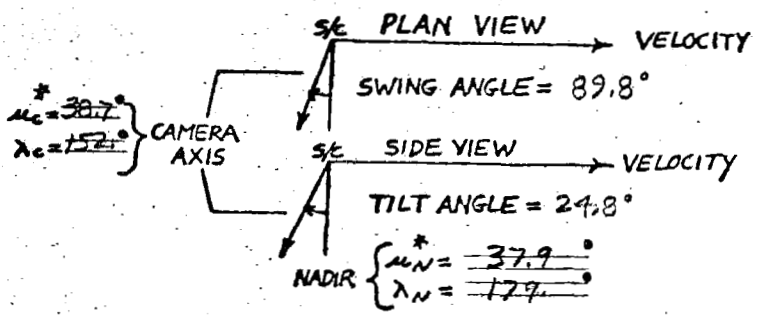
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .07170° 2.18 KM, $\nabla\lambda$ = .16030° 4.85 KM	∇u = .13570° 4.10 KM, $\nabla\lambda$ = .22826° 6.93 KM	∇u = .07665° 2.33 KM, $\nabla\lambda$ = .17606° 5.32 KM	∇u = .04139° 1.26 KM, $\nabla\lambda$ = .15295° 4.65 KM	∇u = .04053° 1.23 KM, $\nabla\lambda$ = .14438° 4.36 KM	∇u = .03945° 1.20 KM, $\nabla\lambda$ = .13458° 4.10 KM	∇u = .06689° 2.03 KM, $\nabla\lambda$ = .14621° 4.42 KM	∇u = .13377° 4.05 KM, $\nabla\lambda$ = .19168° 5.80 KM	∇u = .13967° 4.10 KM, $\nabla\lambda$ = .20773° 6.32 KM
NAVIGATION	∇u = .00554, $\nabla\lambda$ = .00675	∇u = .00561, $\nabla\lambda$ = .00707	∇u = .00551, $\nabla\lambda$ = .00686	∇u = .00549, $\nabla\lambda$ = .00678	∇u = .00551, $\nabla\lambda$ = .00671	∇u = .00553, $\nabla\lambda$ = .00663	∇u = .00557, $\nabla\lambda$ = .00665	∇u = .00573, $\nabla\lambda$ = .00681	∇u = .00567, $\nabla\lambda$ = .00692
ATTITUDE	∇u = .07121, $\nabla\lambda$ = .15958	∇u = .13525, $\nabla\lambda$ = .22715	∇u = .07623, $\nabla\lambda$ = .17529	∇u = .04088, $\nabla\lambda$ = .15280	∇u = .03996, $\nabla\lambda$ = .14394	∇u = .03879, $\nabla\lambda$ = .13416	∇u = .06632, $\nabla\lambda$ = .14552	∇u = .13319, $\nabla\lambda$ = .19058	∇u = .13915, $\nabla\lambda$ = .20662
CAMERA ON-TIME	∇u = .00159, $\nabla\lambda$ = .00011	∇u = .00157, $\nabla\lambda$ = .00028	∇u = .00159, $\nabla\lambda$ = .00016	∇u = .00161, $\nabla\lambda$ = .00001	∇u = .00161, $\nabla\lambda$ = .00002	∇u = .00160, $\nabla\lambda$ = .00005	∇u = .00158, $\nabla\lambda$ = .00006	∇u = .00157, $\nabla\lambda$ = .00019	∇u = .00187, $\nabla\lambda$ = .00023
MOON RADIUS	∇u = .00608, $\nabla\lambda$ = .01365	∇u = .00940, $\nabla\lambda$ = .02136	∇u = .00566, $\nabla\lambda$ = .01495	∇u = .00303, $\nabla\lambda$ = .00955	∇u = .00359, $\nabla\lambda$ = .00817	∇u = .00927, $\nabla\lambda$ = .00829	∇u = .00650, $\nabla\lambda$ = .01243	∇u = .01102, $\nabla\lambda$ = .01438	∇u = .01027, $\nabla\lambda$ = .02026

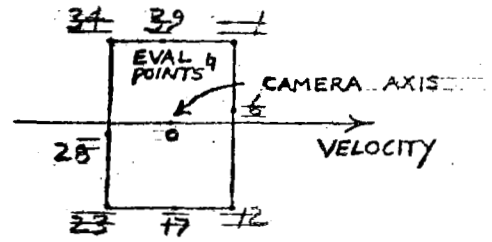
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u = .07345° 2.23 KM, $\nabla\lambda$ = .16539° 5.00 KM	∇u = .55928° 16.8 KM, $\nabla\lambda$ = 1.1687° 35.5 KM	∇u = .87769° 26.6 KM, $\nabla\lambda$ = .30477° 9.21 KM	∇u = .02900° .880 KM, $\nabla\lambda$ = .20944° 6.35 KM	∇u = .02442° .740 KM, $\nabla\lambda$ = .15017° 4.55 KM	∇u = .03031° .920 KM, $\nabla\lambda$ = .10067° 3.06 KM	∇u = .05513° 1.68 KM, $\nabla\lambda$ = .08441° 2.56 KM	∇u = .53788° 16.4 KM, $\nabla\lambda$ = .30584° 9.30 KM	∇u = .44788° 13.6 KM, $\nabla\lambda$ = .49104° 14.9 KM
NAVIGATION	∇u = .00554, $\nabla\lambda$ = .00675	∇u = .00589, $\nabla\lambda$ = .01196	∇u = .00537, $\nabla\lambda$ = .00774	∇u = .00550, $\nabla\lambda$ = .00722	∇u = .00550, $\nabla\lambda$ = .00676	∇u = .00567, $\nabla\lambda$ = .00637	∇u = .00591, $\nabla\lambda$ = .00617	∇u = .00976, $\nabla\lambda$ = .00709	∇u = .00692, $\nabla\lambda$ = .00808
ATTITUDE	∇u = .07297, $\nabla\lambda$ = .16469	∇u = .55386, $\nabla\lambda$ = 1.1669	∇u = .87756, $\nabla\lambda$ = .30385	∇u = .02831, $\nabla\lambda$ = .20914	∇u = .02370, $\nabla\lambda$ = .14995	∇u = .02912, $\nabla\lambda$ = .10047	∇u = .05364, $\nabla\lambda$ = .08383	∇u = .53603, $\nabla\lambda$ = .30366	∇u = .44704, $\nabla\lambda$ = .48995
CAMERA ON-TIME	∇u = .00159, $\nabla\lambda$ = .00011	∇u = .00139, $\nabla\lambda$ = .00120	∇u = .00163, $\nabla\lambda$ = .00049	∇u = .00172, $\nabla\lambda$ = .00001	∇u = .00163, $\nabla\lambda$ = .00016	∇u = .00157, $\nabla\lambda$ = .00029	∇u = .00158, $\nabla\lambda$ = .00011	∇u = .00217, $\nabla\lambda$ = .00028	∇u = .00165, $\nabla\lambda$ = .00029
MOON RADIUS	∇u = .00608, $\nabla\lambda$ = .01365	∇u = .02092, $\nabla\lambda$ = .06330	∇u = .00160, $\nabla\lambda$ = .02229	∇u = .00250, $\nabla\lambda$ = .00871	∇u = .00129, $\nabla\lambda$ = .00963	∇u = .00605, $\nabla\lambda$ = .00074	∇u = .01114, $\nabla\lambda$ = .00773	∇u = .04349, $\nabla\lambda$ = .03310	∇u = .02698, $\nabla\lambda$ = .03866

* u = LATITUDE λ = LONGITUDE

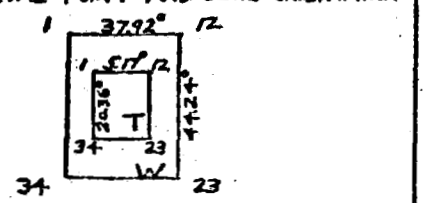
ERROR ANALYSIS RESULTS MISSION V FRAME 103





S/C ALTITUDE = ~~123~~ KM
TRUE ANOMALY = ~~140~~ °
INCLINATION ≈ ~~95~~ °
NOTE: ~~R(140°) P(15°, 710°)~~

EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

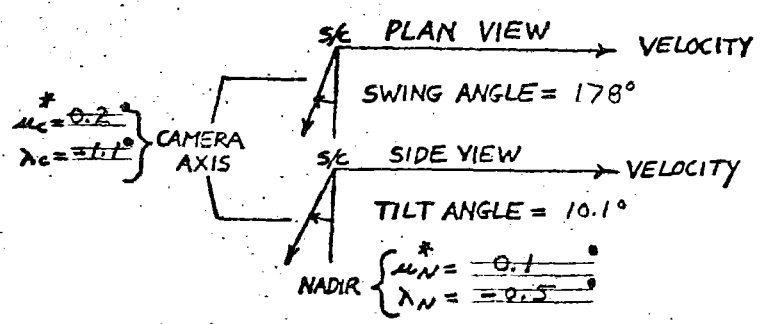
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u=.05312° 1.61 KM $\nabla\lambda$=.03131° .950 KM	∇u=.05173° 1.56 KM $\nabla\lambda$=.35196° 1.07 KM	∇u=.04764° 1.44 KM $\nabla\lambda$=.28016° .850 KM	∇u=.07044° 2.14 KM $\nabla\lambda$=.27043° 8.29 KM	∇u=.08195° 2.48 KM $\nabla\lambda$=.30344° 9.29 KM	∇u=.10978° 3.32 KM $\nabla\lambda$=.36393° 11.1 KM	∇u=.06924° 2.10 KM $\nabla\lambda$=.36209° 1.10 KM	∇u=.05794° 1.75 KM $\nabla\lambda$=.48996° 14.8 KM	∇u=.05055° 1.54 KM $\nabla\lambda$=.41306° 12.5 KM
NAVIGATION	∇u=.00415 $\nabla\lambda$=.00874	∇u=.00416 $\nabla\lambda$=.00975	∇u=.00412 $\nabla\lambda$=.00830	∇u=.00453 $\nabla\lambda$=.00746	∇u=.00466 $\nabla\lambda$=.00791	∇u=.00496 $\nabla\lambda$=.00874	∇u=.00426 $\nabla\lambda$=.00991	∇u=.00409 $\nabla\lambda$=.01196	∇u=.00412 $\nabla\lambda$=.01073
ATTITUDE	∇u=.05292 $\nabla\lambda$=.31255	∇u=.05138 $\nabla\lambda$=.35135	∇u=.04745 $\nabla\lambda$=.27966	∇u=.07002 $\nabla\lambda$=.27000	∇u=.08150 $\nabla\lambda$=.30293	∇u=.10928 $\nabla\lambda$=.36329	∇u=.06903 $\nabla\lambda$=.36137	∇u=.05772 $\nabla\lambda$=.48898	∇u=.05029 $\nabla\lambda$=.41228
CAMERA ON-TIME	∇u=.00103 $\nabla\lambda$=.00048	∇u=.00105 $\nabla\lambda$=.00073	∇u=.00104 $\nabla\lambda$=.00044	∇u=.00114 $\nabla\lambda$=.00021	∇u=.00115 $\nabla\lambda$=.00022	∇u=.00115 $\nabla\lambda$=.00022	∇u=.00102 $\nabla\lambda$=.00051	∇u=.00099 $\nabla\lambda$=.00107	∇u=.00102 $\nabla\lambda$=.00089
MOON RADIUS	∇u=.00146 $\nabla\lambda$=.01722	∇u=.00429 $\nabla\lambda$=.01816	∇u=.00031 $\nabla\lambda$=.01448	∇u=.00610 $\nabla\lambda$=.01339	∇u=.00716 $\nabla\lambda$=.01582	∇u=.00917 $\nabla\lambda$=.01979	∇u=.00309 $\nabla\lambda$=.02071	∇u=.00269 $\nabla\lambda$=.02857	∇u=.00863 $\nabla\lambda$=.02309

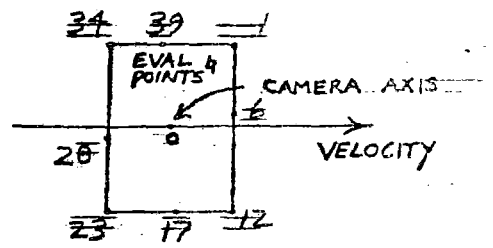
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	∇u=.05271° 1.59 KM $\nabla\lambda$=.31625° 9.59 KM	∇u=.01684° .510 KM $\nabla\lambda$=.30954° 9.38 KM	∇u=.10043° 3.03 KM $\nabla\lambda$=.19142° 5.80 KM	∇u=.14018° 4.25 KM $\nabla\lambda$=.21704° 6.60 KM	∇u=.22913° 6.93 KM $\nabla\lambda$=.40389° 12.2 KM	∇u= ° KM $\nabla\lambda$= ° KM	∇u= ° KM $\nabla\lambda$= ° KM	∇u= ° KM $\nabla\lambda$= ° KM	∇u=.07378° 2.23 KM $\nabla\lambda$=1.4402° 43.5 KM
NAVIGATION	∇u=.00415 $\nabla\lambda$=.00874	∇u=.00482 $\nabla\lambda$=.00924	∇u=.00418 $\nabla\lambda$=.00689	∇u=.00512 $\nabla\lambda$=.00577	∇u=.00690 $\nabla\lambda$=.00792	∇u= $\nabla\lambda$= N/A	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u=.00438 $\nabla\lambda$=.02816
ATTITUDE	∇u=.05252 $\nabla\lambda$=.31566	∇u=.16801 $\nabla\lambda$=.30940	∇u=.10033 $\nabla\lambda$=.19127	∇u=.13972 $\nabla\lambda$=.21692	∇u=.22819 $\nabla\lambda$=.40339	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$= N/A	∇u= $\nabla\lambda$=	∇u=.07309 $\nabla\lambda$=1.4376
CAMERA ON-TIME	∇u=.00103 $\nabla\lambda$=.00048	∇u=.00120 $\nabla\lambda$=.00027	∇u=.00109 $\nabla\lambda$=.00020	∇u=.00139 $\nabla\lambda$=.00008	∇u=.00165 $\nabla\lambda$=.00019	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u=.00103 $\nabla\lambda$=.00417
MOON RADIUS	∇u=.00146 $\nabla\lambda$=.01722	∇u=.01065 $\nabla\lambda$=.00194	∇u=.00103 $\nabla\lambda$=.00290	∇u=.01007 $\nabla\lambda$=.00428	∇u=.01950 $\nabla\lambda$=.01833	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u= $\nabla\lambda$=	∇u=.00940 $\nabla\lambda$=.08308

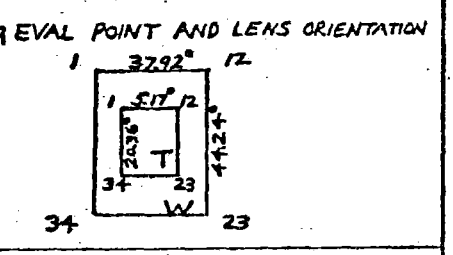
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 109





S/C ALTITUDE = 97.3 KM
TRUE ANOMALY = 358 °
INCLINATION ≈ 85 °
NOTE: APOLLO TGT T-27A
R(32°) P(-2.5°) Y(-73°)



TELEPHOTO LENS, T

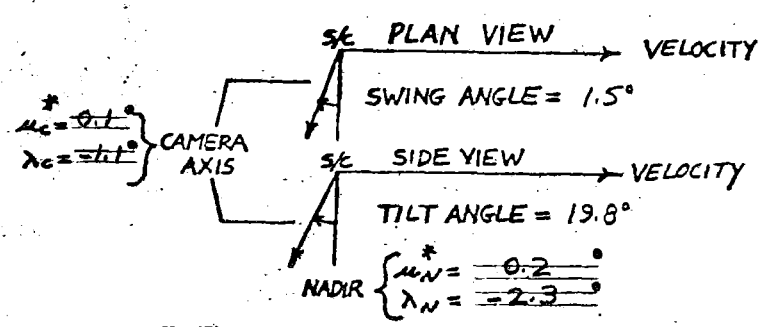
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00943° .231 KM σ_λ = .00880° .266 KM	σ_u = .01137° .344 KM σ_λ = .01019° .309 KM	σ_u = .00959° .290 KM σ_λ = .00853° .258 KM	σ_u = .00817° .248 KM σ_λ = .00792° .240 KM	σ_u = .00819° .248 KM σ_λ = .00827° .251 KM	σ_u = .00826° .251 KM σ_λ = .00872° .264 KM	σ_u = .00934° .283 KM σ_λ = .00912° .276 KM	σ_u = .01129° .342 KM σ_λ = .01097° .332 KM	σ_u = .01130° .342 KM σ_λ = .01060° .321 KM
NAVIGATION	σ_u = .00657 σ_λ = .00194	σ_u = .00654 σ_λ = .00197	σ_u = .00655 σ_λ = .00194	σ_u = .00656 σ_λ = .00190	σ_u = .00658 σ_λ = .00190	σ_u = .00661 σ_λ = .00190	σ_u = .00660 σ_λ = .00194	σ_u = .00659 σ_λ = .00200	σ_u = .00657 σ_λ = .00200
ATTITUDE	σ_u = .00652 σ_λ = .00822	σ_u = .00907 σ_λ = .00860	σ_u = .00673 σ_λ = .00796	σ_u = .00449 σ_λ = .00769	σ_u = .00452 σ_λ = .00805	σ_u = .00457 σ_λ = .00851	σ_u = .00634 σ_λ = .00861	σ_u = .00899 σ_λ = .00944	σ_u = .00902 σ_λ = .00904
CAMERA ON-TIME	σ_u = .00180 σ_λ = .00014	σ_u = .00180 σ_λ = .00014	σ_u = .00180 σ_λ = .00014	σ_u = .00180 σ_λ = .00014	σ_u = .00180 σ_λ = .00014	σ_u = .00180 σ_λ = .00014	σ_u = .00180 σ_λ = .00014	σ_u = .00180 σ_λ = .00015	σ_u = .00180 σ_λ = .00015
MOON RADIUS	σ_u = .00010 σ_λ = .00248	σ_u = .00078 σ_λ = .00510	σ_u = .00076 σ_λ = .00266	σ_u = .00051 σ_λ = .00206	σ_u = .00005 σ_λ = .00001	σ_u = .00072 σ_λ = .00004	σ_u = .00055 σ_λ = .00230	σ_u = .00034 σ_λ = .00521	σ_u = .00026 σ_λ = .00516

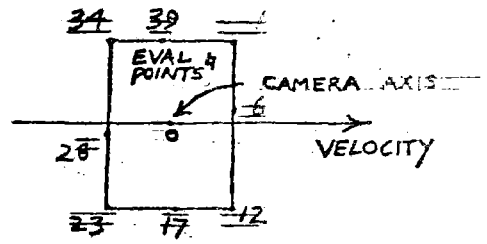
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00994° .301 KM σ_λ = .00903° .275 KM	σ_u = .01785° .541 KM σ_λ = .01271° .386 KM	σ_u = .01183° .359 KM σ_λ = .00734° .222 KM	σ_u = .00880° .267 KM σ_λ = .00784° .237 KM	σ_u = .00768° .232 KM σ_λ = .00737° .224 KM	σ_u = .00963° .292 KM σ_λ = .01318° .399 KM	σ_u = .01135° .344 KM σ_λ = .01263° .383 KM	σ_u = .01588° .481 KM σ_λ = .01820° .552 KM	σ_u = .01518° .460 KM σ_λ = .01504° .455 KM
NAVIGATION	σ_u = .00657 σ_λ = .00194	σ_u = .00670 σ_λ = .00204	σ_u = .00643 σ_λ = .00193	σ_u = .00645 σ_λ = .00187	σ_u = .00650 σ_λ = .00186	σ_u = .00652 σ_λ = .00186	σ_u = .00681 σ_λ = .00195	σ_u = .00682 σ_λ = .00217	σ_u = .00657 σ_λ = .00210
ATTITUDE	σ_u = .00723 σ_λ = .00852	σ_u = .01546 σ_λ = .00920	σ_u = .00837 σ_λ = .00659	σ_u = .00389 σ_λ = .00685	σ_u = .00353 σ_λ = .00867	σ_u = .00437 σ_λ = .01279	σ_u = .00750 σ_λ = .01224	σ_u = .01341 σ_λ = .01539	σ_u = .01357 σ_λ = .01190
CAMERA ON-TIME	σ_u = .00180 σ_λ = .00014	σ_u = .00181 σ_λ = .00012	σ_u = .00180 σ_λ = .00014	σ_u = .00180 σ_λ = .00015	σ_u = .00180 σ_λ = .00014	σ_u = .00181 σ_λ = .00013	σ_u = .00181 σ_λ = .00015	σ_u = .00181 σ_λ = .00016	σ_u = .00180 σ_λ = .00015
MOON RADIUS	σ_u = .00010 σ_λ = .00248	σ_u = .00597 σ_λ = .00852	σ_u = .00502 σ_λ = .00260	σ_u = .00417 σ_λ = .00332	σ_u = .00005 σ_λ = .00297	σ_u = .00487 σ_λ = .00259	σ_u = .00478 σ_λ = .00239	σ_u = .00474 σ_λ = .00946	σ_u = .00016 σ_λ = .00896

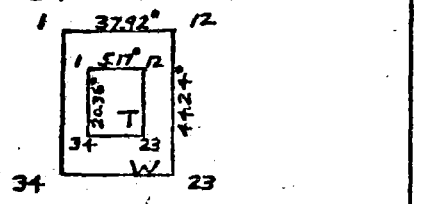
* σ_u = LATITUDE σ_λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION II FRAME 113





S/C ALTITUDE = 97.4 KM
TRUE ANOMALY = 358 °
INCLINATION ≈ 85. °
NOTE: Apollo TGT. T=27B
t1



TELEPHOTO LENS, T

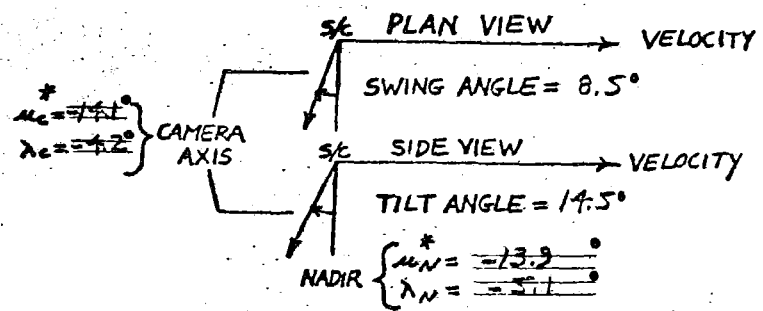
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00912° (.276 KM), σ_λ = .01043° (.316 KM)	σ_u = .01098° (.332 KM), σ_λ = .00802° (.243 KM)	σ_u = .00914° (.278 KM), σ_λ = .00975° (.296 KM)	σ_u = .00719° (.218 KM), σ_λ = .01332° (.405 KM)	σ_u = .00736° (.223 KM), σ_λ = .01378° (.417 KM)	σ_u = .00771° (.234 KM), σ_λ = .01440° (.436 KM)	σ_u = .00920° (.279 KM), σ_λ = .01117° (.338 KM)	σ_u = .01121° (.340 KM), σ_λ = .00886° (.269 KM)	σ_u = .01107° (.336 KM), σ_λ = .00846° (.257 KM)
NAVIGATION	σ_u = .00439, σ_λ = .00112	σ_u = .00437, σ_λ = .00112	σ_u = .00437, σ_λ = .00112	σ_u = .00439, σ_λ = .00113	σ_u = .00439, σ_λ = .00113	σ_u = .00439, σ_λ = .00112	σ_u = .00439, σ_λ = .00112	σ_u = .00437, σ_λ = .00112	σ_u = .00439, σ_λ = .00112
ATTITUDE	σ_u = .00783, σ_λ = .00908	σ_u = .00995, σ_λ = .00758	σ_u = .00789, σ_λ = .00841	σ_u = .00549, σ_λ = .01045	σ_u = .00567, σ_λ = .01108	σ_u = .00596, σ_λ = .01188	σ_u = .00784, σ_λ = .00981	σ_u = .01016, σ_λ = .00848	σ_u = .01004, σ_λ = .00805
CAMERA ON-TIME	σ_u = .00152, σ_λ = .00012	σ_u = .00152, σ_λ = .00012	σ_u = .00152, σ_λ = .00012	σ_u = .00152, σ_λ = .00012	σ_u = .00152, σ_λ = .00011	σ_u = .00152, σ_λ = .00011	σ_u = .00152, σ_λ = .00011	σ_u = .00152, σ_λ = .00012	σ_u = .00152, σ_λ = .00012
MOON RADIUS	σ_u = .00052, σ_λ = .00500	σ_u = .00031, σ_λ = .00239	σ_u = .00016, σ_λ = .00480	σ_u = .00005, σ_λ = .00317	σ_u = .00071, σ_λ = .00812	σ_u = .00150, σ_λ = .00806	σ_u = .00122, σ_λ = .00521	σ_u = .00093, σ_λ = .00229	σ_u = .00037, σ_λ = .00234

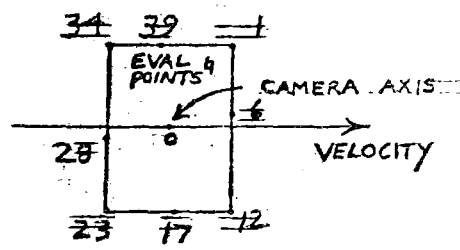
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .00991° (.300 KM), σ_λ = .01072° (.325 KM)	σ_u = .01608° (.486 KM), σ_λ = .00624° (.189 KM)	σ_u = .01169° (.354 KM), σ_λ = .00848° (.257 KM)	σ_u = .00858° (.260 KM), σ_λ = .01828° (.554 KM)	σ_u = .00649° (.197 KM), σ_λ = .02070° (.627 KM)	σ_u = .01315° (.398 KM), σ_λ = .02888° (.875 KM)	σ_u = .01393° (.423 KM), σ_λ = .01618° (.490 KM)	σ_u = .01671° (.507 KM), σ_λ = .01111° (.336 KM)	σ_u = .01448° (.439 KM), σ_λ = .00822° (.249 KM)
NAVIGATION	σ_u = .00439, σ_λ = .00112	σ_u = .00440, σ_λ = .00112	σ_u = .00441, σ_λ = .00115	σ_u = .00442, σ_λ = .00123	σ_u = .00439, σ_λ = .00115	σ_u = .00447, σ_λ = .00107	σ_u = .00445, σ_λ = .00109	σ_u = .00443, σ_λ = .00113	σ_u = .00439, σ_λ = .00112
ATTITUDE	σ_u = .00874, σ_λ = .00941	σ_u = .01476, σ_λ = .00613	σ_u = .00971, σ_λ = .00684	σ_u = .00510, σ_λ = .01217	σ_u = .00448, σ_λ = .01604	σ_u = .00974, σ_λ = .02591	σ_u = .01176, σ_λ = .01528	σ_u = .01539, σ_λ = .01101	σ_u = .01371, σ_λ = .00812
CAMERA ON-TIME	σ_u = .00152, σ_λ = .00012	σ_u = .00153, σ_λ = .00012	σ_u = .00153, σ_λ = .00013	σ_u = .00153, σ_λ = .00015	σ_u = .00152, σ_λ = .00011	σ_u = .00155, σ_λ = .00007	σ_u = .00154, σ_λ = .00010	σ_u = .00154, σ_λ = .00012	σ_u = .00152, σ_λ = .00012
MOON RADIUS	σ_u = .00052, σ_λ = .00500	σ_u = .00433, σ_λ = .00021	σ_u = .00455, σ_λ = .00487	σ_u = .00505, σ_λ = .01358	σ_u = .00063, σ_λ = .01303	σ_u = .00747, σ_λ = .01270	σ_u = .00579, σ_λ = .00522	σ_u = .00452, σ_λ = .00083	σ_u = .00046, σ_λ = .00060

* u = LATITUDE λ = LONGITUDE

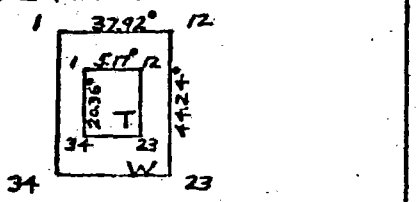
ERROR ANALYSIS RESULTS MISSION V FRAME 117





S/C ALTITUDE = 112.7 KM
TRUE ANOMALY = 344. °
INCLINATION ≈ 85. °
NOTE: R(39°) P(1°) Y(-80°)
t4

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

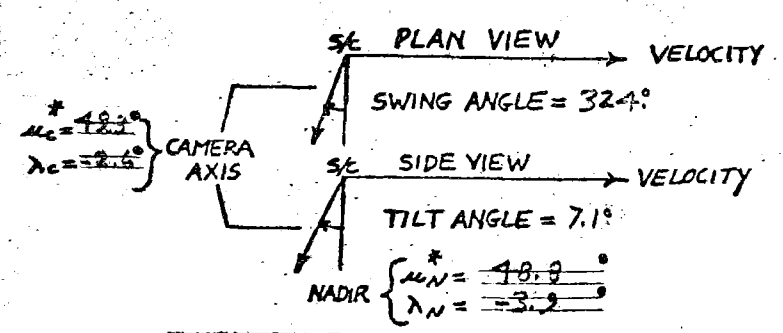
ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\sqrt{u}$ = .01234° .373 KM; $\sqrt{\lambda}$ = .01130° .343 KM	$\sqrt{u}$ = .01419° .430 KM; $\sqrt{\lambda}$ = .00936° .284 KM	$\sqrt{u}$ = .01237° .275 KM; $\sqrt{\lambda}$ = .01054° .318 KM	$\sqrt{u}$ = .01059° .321 KM; $\sqrt{\lambda}$ = .01348° .409 KM	$\sqrt{u}$ = .01074° .325 KM; $\sqrt{\lambda}$ = .01407° .426 KM	$\sqrt{u}$ = .01101° .335 KM; $\sqrt{\lambda}$ = .01485° .451 KM	$\sqrt{u}$ = .01240° .375 KM; $\sqrt{\lambda}$ = .01213° .367 KM	$\sqrt{u}$ = .01445° .437 KM; $\sqrt{\lambda}$ = .01043° .315 KM	$\sqrt{u}$ = .01430° .434 KM; $\sqrt{\lambda}$ = .00993° .301 KM
NAVIGATION	$\sqrt{u}$ = .00831	$\sqrt{\lambda}$ = .00183	$\sqrt{u}$ = .00829	$\sqrt{\lambda}$ = .00185	$\sqrt{u}$ = .00830	$\sqrt{\lambda}$ = .00183	$\sqrt{u}$ = .00830	$\sqrt{\lambda}$ = .00181	$\sqrt{u}$ = .00832	$\sqrt{\lambda}$ = .00181	$\sqrt{u}$ = .00834	$\sqrt{\lambda}$ = .00181	$\sqrt{u}$ = .00833	$\sqrt{\lambda}$ = .00182	$\sqrt{u}$ = .00832	$\sqrt{\lambda}$ = .00186	$\sqrt{u}$ = .00831	$\sqrt{\lambda}$ = .00185
ATTITUDE	$\sqrt{u}$ = .00896	$\sqrt{\lambda}$ = .01054	$\sqrt{u}$ = .01142	$\sqrt{\lambda}$ = .00911	$\sqrt{u}$ = .00905	$\sqrt{\lambda}$ = .00979	$\sqrt{u}$ = .00640	$\sqrt{\lambda}$ = .01159	$\sqrt{u}$ = .00650	$\sqrt{\lambda}$ = .01229	$\sqrt{u}$ = .00683	$\sqrt{\lambda}$ = .01319	$\sqrt{u}$ = .00894	$\sqrt{\lambda}$ = .01136	$\sqrt{u}$ = .01165	$\sqrt{\lambda}$ = .01022	$\sqrt{u}$ = .01152	$\sqrt{\lambda}$ = .00970
CAMERA ON-TIME	$\sqrt{u}$ = .00152	$\sqrt{\lambda}$ = .00009	$\sqrt{u}$ = .00151	$\sqrt{\lambda}$ = .00117	$\sqrt{u}$ = .00151	$\sqrt{\lambda}$ = .00010	$\sqrt{u}$ = .00151	$\sqrt{\lambda}$ = .00007	$\sqrt{u}$ = .00152	$\sqrt{\lambda}$ = .00007	$\sqrt{u}$ = .00152	$\sqrt{\lambda}$ = .00007	$\sqrt{u}$ = .00152	$\sqrt{\lambda}$ = .00009	$\sqrt{u}$ = .00152	$\sqrt{\lambda}$ = .00012	$\sqrt{u}$ = .00151	$\sqrt{\lambda}$ = .00012
MOON RADIUS	$\sqrt{u}$ = .00078	$\sqrt{\lambda}$ = .00365	$\sqrt{u}$ = .00003	$\sqrt{\lambda}$ = .00105	$\sqrt{u}$ = .00011	$\sqrt{\lambda}$ = .00344	$\sqrt{u}$ = .00028	$\sqrt{\lambda}$ = .00664	$\sqrt{u}$ = .00090	$\sqrt{\lambda}$ = .00661	$\sqrt{u}$ = .00166	$\sqrt{\lambda}$ = .00658	$\sqrt{u}$ = .00195	$\sqrt{\lambda}$ = .00386	$\sqrt{u}$ = .00121	$\sqrt{\lambda}$ = .00096	$\sqrt{u}$ = .00065	$\sqrt{\lambda}$ = .00100

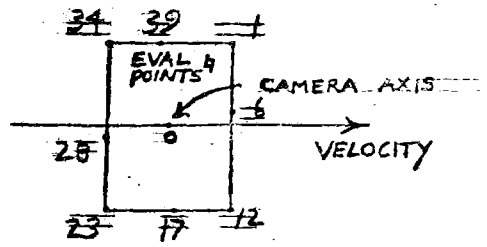
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\sqrt{u}$ = .01307° .397 KM; $\sqrt{\lambda}$ = .01171° .355 KM	$\sqrt{u}$ = .01933° .585 KM; $\sqrt{\lambda}$ = .00786° .238 KM	$\sqrt{u}$ = .01438° .436 KM; $\sqrt{\lambda}$ = .00855° .259 KM	$\sqrt{u}$ = .01119° .340 KM; $\sqrt{\lambda}$ = .01657° .503 KM	$\sqrt{u}$ = .00997° .301 KM; $\sqrt{\lambda}$ = .02003° .608 KM	$\sqrt{u}$ = .01490° .451 KM; $\sqrt{\lambda}$ = .02939° .890 KM	$\sqrt{u}$ = .01667° .507 KM; $\sqrt{\lambda}$ = .01821° .550 KM	$\sqrt{u}$ = .02037° .618 KM; $\sqrt{\lambda}$ = .01419° .430 KM	$\sqrt{u}$ = .01801° .545 KM; $\sqrt{\lambda}$ = .01057° .321 KM
NAVIGATION	$\sqrt{u}$ = .00831	$\sqrt{\lambda}$ = .00183	$\sqrt{u}$ = .00825	$\sqrt{\lambda}$ = .00187	$\sqrt{u}$ = .00826	$\sqrt{\lambda}$ = .00184	$\sqrt{u}$ = .00827	$\sqrt{\lambda}$ = .00185	$\sqrt{u}$ = .00831	$\sqrt{\lambda}$ = .00181	$\sqrt{u}$ = .00858	$\sqrt{\lambda}$ = .00178	$\sqrt{u}$ = .00852	$\sqrt{\lambda}$ = .00181	$\sqrt{u}$ = .00847	$\sqrt{\lambda}$ = .00193	$\sqrt{u}$ = .00831	$\sqrt{\lambda}$ = .00190
ATTITUDE	$\sqrt{u}$ = .00994	$\sqrt{\lambda}$ = .01097	$\sqrt{u}$ = .01693	$\sqrt{\lambda}$ = .00745	$\sqrt{u}$ = .01092	$\sqrt{\lambda}$ = .00761	$\sqrt{u}$ = .00589	$\sqrt{\lambda}$ = .01205	$\sqrt{u}$ = .00525	$\sqrt{\lambda}$ = .01669	$\sqrt{u}$ = .00974	$\sqrt{\lambda}$ = .02720	$\sqrt{u}$ = .01294	$\sqrt{\lambda}$ = .01769	$\sqrt{u}$ = .01780	$\sqrt{\lambda}$ = .01384	$\sqrt{u}$ = .01589	$\sqrt{\lambda}$ = .01020
CAMERA ON-TIME	$\sqrt{u}$ = .00152	$\sqrt{\lambda}$ = .00009	$\sqrt{u}$ = .00149	$\sqrt{\lambda}$ = .00013	$\sqrt{u}$ = .00149	$\sqrt{\lambda}$ = .00010	$\sqrt{u}$ = .00149	$\sqrt{\lambda}$ = .00004	$\sqrt{u}$ = .00152	$\sqrt{\lambda}$ = .00004	$\sqrt{u}$ = .00158	$\sqrt{\lambda}$ = 0	$\sqrt{u}$ = .00157	$\sqrt{\lambda}$ = .00008	$\sqrt{u}$ = .00155	$\sqrt{\lambda}$ = .00015	$\sqrt{u}$ = .00152	$\sqrt{\lambda}$ = .00014
MOON RADIUS	$\sqrt{u}$ = .00078	$\sqrt{\lambda}$ = .00365	$\sqrt{u}$ = .00409	$\sqrt{\lambda}$ = .00163	$\sqrt{u}$ = .00415	$\sqrt{\lambda}$ = .00344	$\sqrt{u}$ = .00996	$\sqrt{\lambda}$ = .01123	$\sqrt{u}$ = .00072	$\sqrt{\lambda}$ = .01100	$\sqrt{u}$ = .00715	$\sqrt{\lambda}$ = .01100	$\sqrt{u}$ = .00597	$\sqrt{\lambda}$ = .00395	$\sqrt{u}$ = .00494	$\sqrt{\lambda}$ = .00244	$\sqrt{u}$ = .00076	$\sqrt{\lambda}$ = .00209

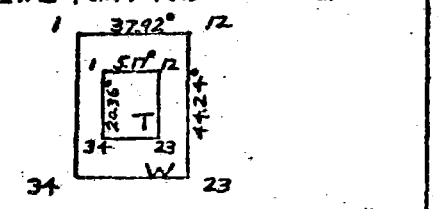
* u = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 130





S/C ALTITUDE = ~~233.5~~ KM
TRUE ANOMALY = ~~47.8~~ °
INCLINATION = ~~85.~~ °
NOTE: ~~P1(-16°) P(-39°) T(-33°)~~
t4



TELEPHOTO LENS, T

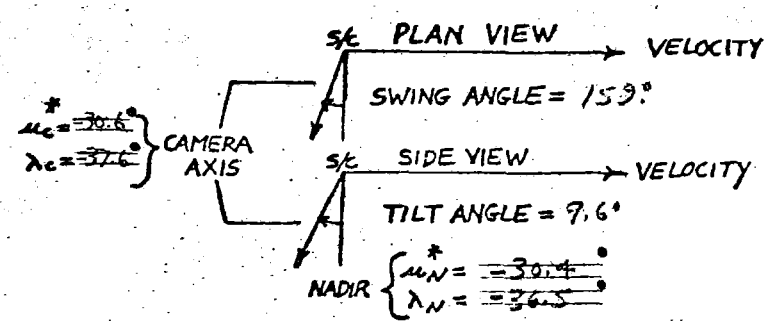
ERROR SOURCE	CAMERA AXIS (0)		EVAL POINT 1		EVAL POINT 6		EVAL POINT 12		EVAL POINT 17		EVAL POINT 23		EVAL POINT 28		EVAL POINT 34		EVAL POINT 39	
TOTAL	σ_μ = .02023° .612 KM	σ_λ = .02666° .805 KM	σ_μ = .02509° .760 KM	σ_λ = .02569° .778 KM	σ_μ = .02059° .622 KM	σ_λ = .02562° .776 KM	σ_μ = .01635° .495 KM	σ_λ = .02897° .879 KM	σ_μ = .01651° .500 KM	σ_λ = .02986° .907 KM	σ_μ = .01682° .502 KM	σ_λ = .03113° .945 KM	σ_μ = .02001° .608 KM	σ_λ = .02792° .848 KM	σ_μ = .02494° .757 KM	σ_λ = .02749° .835 KM	σ_μ = .02496° .760 KM	σ_λ = .02660° .808 KM
NAVIGATION	σ_μ = .01062	σ_λ = .00761	σ_μ = .01063	σ_λ = .00763	σ_μ = .01060	σ_λ = .00766	σ_μ = .01057	σ_λ = .00779	σ_μ = .01059	σ_λ = .00772	σ_μ = .01062	σ_λ = .00763	σ_μ = .01064	σ_λ = .00755	σ_μ = .01067	σ_λ = .00752	σ_μ = .01065	σ_λ = .00757
ATTITUDE	σ_μ = .01714	σ_λ = .02543	σ_μ = .02260	σ_λ = .02448	σ_μ = .01752	σ_λ = .02434	σ_μ = .01235	σ_λ = .02700	σ_μ = .01259	σ_λ = .02603	σ_μ = .01298	σ_λ = .02947	σ_μ = .01688	σ_λ = .02673	σ_μ = .02249	σ_λ = .02639	σ_μ = .02249	σ_λ = .02595
CAMERA ON-TIME	σ_μ = .00142	σ_λ = .00035	σ_μ = .00145	σ_λ = .00023	σ_μ = .00144	σ_λ = .00035	σ_μ = .00142	σ_λ = .00050	σ_μ = .00141	σ_λ = .00049	σ_μ = .00140	σ_λ = .00047	σ_μ = .00141	σ_λ = .00036	σ_μ = .00142	σ_λ = .00022	σ_μ = .00143	σ_λ = .00022
MOON RADIUS	σ_μ = .00085	σ_λ = .00252	σ_μ = .00189	σ_λ = .00146	σ_μ = .00157	σ_λ = .00233	σ_μ = .00100	σ_λ = .00703	σ_μ = .00038	σ_λ = .00679	σ_μ = .00036	σ_λ = .00650	σ_μ = .00019	σ_λ = .00271	σ_μ = .00056	σ_λ = .00168	σ_μ = .00117	σ_λ = .00158

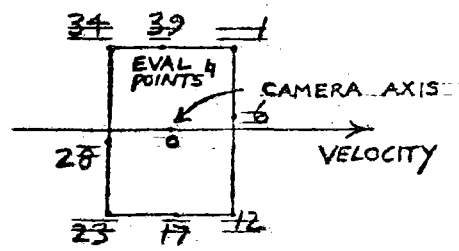
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS		EVAL POINT 1		EVAL POINT 6		EVAL POINT 12		EVAL POINT 17		EVAL POINT 23		EVAL POINT 28		EVAL POINT 34		EVAL POINT 39	
TOTAL	σ_μ = .02191° .665 KM	σ_λ = .02708° .821 KM	σ_μ = .03999° 1.21 KM	σ_λ = .02948° .893 KM	σ_μ = .02577° .785 KM	σ_λ = .02735° .830 KM	σ_μ = .01611° .486 KM	σ_λ = .03917° 1.19 KM	σ_μ = .01518° .461 KM	σ_λ = .03884° 118 KM	σ_μ = .02146° .652 KM	σ_λ = .05225° 1.59 KM	σ_μ = .02509° .761 KM	σ_λ = .03831° 1.16 KM	σ_μ = .03446° 1.04 KM	σ_λ = .03854° 1.17 KM	σ_μ = .03365° 1.02 KM	σ_λ = .03162° .960 KM
NAVIGATION	σ_μ = .01062	σ_λ = .00761	σ_μ = .01074	σ_λ = .00801	σ_μ = .01066	σ_λ = .00813	σ_μ = .01050	σ_λ = .00891	σ_μ = .01052	σ_λ = .00801	σ_μ = .01099	σ_λ = .00730	σ_μ = .01096	σ_λ = .00719	σ_μ = .01097	σ_λ = .00733	σ_μ = .01069	σ_λ = .00759
ATTITUDE	σ_μ = .01909	σ_λ = .02586	σ_μ = .03788	σ_λ = .02758	σ_μ = .02254	σ_λ = .02590	σ_μ = .01109	σ_λ = .03448	σ_μ = .01085	σ_λ = .03578	σ_μ = .01741	σ_λ = .05073	σ_μ = .02212	σ_λ = .03757	σ_μ = .03248	σ_λ = .03720	σ_μ = .03186	σ_λ = .02995
CAMERA ON-TIME	σ_μ = .00142	σ_λ = .00036	σ_μ = .00157	σ_λ = .00005	σ_μ = .00155	σ_λ = .00041	σ_μ = .00149	σ_λ = .00089	σ_μ = .00139	σ_λ = .00068	σ_μ = .00132	σ_λ = .00052	σ_μ = .00135	σ_λ = .00031	σ_μ = .00137	σ_λ = .00008	σ_μ = .00149	σ_λ = .00006
MOON RADIUS	σ_μ = .00085	σ_λ = .00252	σ_μ = .00682	σ_λ = .00064	σ_μ = .00631	σ_λ = .00328	σ_μ = .00491	σ_λ = .01628	σ_μ = .00018	σ_λ = .01279	σ_μ = .00590	σ_λ = .01014	σ_μ = .00421	σ_λ = .00293	σ_μ = .00344	σ_λ = .00690	σ_μ = .00106	σ_λ = .00670

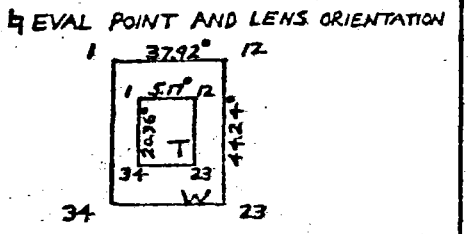
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 168





S/C ALTITUDE = 167.4 KM
TRUE ANOMALY = 227. °
INCLINATION ≈ 85. °
NOTE: ~~R(60°) P(-14°) Y(-70°)~~



TELEPHOTO LENS, T

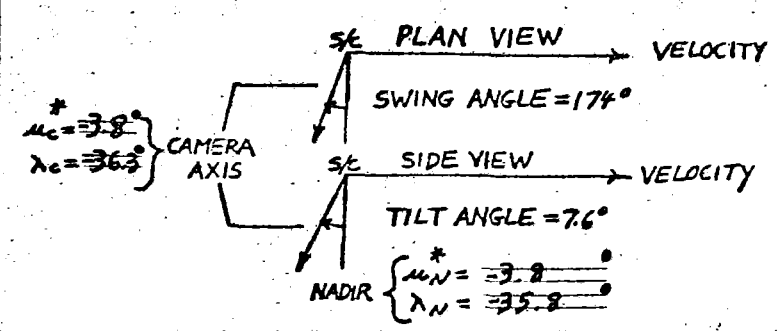
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\sqrt{u}$=.01859° .563 KM, $\sqrt{\lambda}$=.01775° .539 KM	$\sqrt{u}$=.02187° .664 KM, $\sqrt{\lambda}$=.01880° .570 KM	$\sqrt{u}$=.01871° .568 KM, $\sqrt{\lambda}$=.01691° .512 KM	$\sqrt{u}$=.01618° .490 KM, $\sqrt{\lambda}$=.01655° .500 KM	$\sqrt{u}$=.01633° .495 KM, $\sqrt{\lambda}$=.01743° .530 KM	$\sqrt{u}$=.01656° .502 KM, $\sqrt{\lambda}$=.01855° .561 KM	$\sqrt{u}$=.01854° .561 KM, $\sqrt{\lambda}$=.01868° .568 KM	$\sqrt{u}$=.02207° .670 KM, $\sqrt{\lambda}$=.02079° .629 KM	$\sqrt{u}$=.02195° .665 KM, $\sqrt{\lambda}$=.01983° .600 KM
NAVIGATION	$\sqrt{u}$=.01260	$\sqrt{\lambda}$=.00415	$\sqrt{u}$=.01242	$\sqrt{\lambda}$=.00466	$\sqrt{u}$=.01250	$\sqrt{\lambda}$=.00416	$\sqrt{u}$=.01257	$\sqrt{\lambda}$=.00364	$\sqrt{u}$=.01266	$\sqrt{\lambda}$=.00365	$\sqrt{u}$=.01277	$\sqrt{\lambda}$=.00368	$\sqrt{u}$=.01271	$\sqrt{\lambda}$=.00414	$\sqrt{u}$=.01263	$\sqrt{\lambda}$=.00477	$\sqrt{u}$=.01253	$\sqrt{\lambda}$=.00472
ATTITUDE	$\sqrt{u}$=.01353	$\sqrt{\lambda}$=.01704	$\sqrt{u}$=.01792	$\sqrt{\lambda}$=.01725	$\sqrt{u}$=.01381	$\sqrt{\lambda}$=.01612	$\sqrt{u}$=.01003	$\sqrt{\lambda}$=.01614	$\sqrt{u}$=.01014	$\sqrt{\lambda}$=.01704	$\sqrt{u}$=.01031	$\sqrt{\lambda}$=.01818	$\sqrt{u}$=.01332	$\sqrt{\lambda}$=.01803	$\sqrt{u}$=.01800	$\sqrt{\lambda}$=.01923	$\sqrt{u}$=.01794	$\sqrt{\lambda}$=.01830
CAMERA ON-TIME	$\sqrt{u}$=.00174	$\sqrt{\lambda}$=.00254	$\sqrt{u}$=.00172	$\sqrt{\lambda}$=.00032	$\sqrt{u}$=.00172	$\sqrt{\lambda}$=.00026	$\sqrt{u}$=.00173	$\sqrt{\lambda}$=.00019	$\sqrt{u}$=.00174	$\sqrt{\lambda}$=.00019	$\sqrt{u}$=.00175	$\sqrt{\lambda}$=.00019	$\sqrt{u}$=.00175	$\sqrt{\lambda}$=.00025	$\sqrt{u}$=.00174	$\sqrt{\lambda}$=.00033	$\sqrt{u}$=.00173	$\sqrt{\lambda}$=.00033
MOON RADIUS	$\sqrt{u}$=.00060	$\sqrt{\lambda}$=.00276	$\sqrt{u}$=.00044	$\sqrt{\lambda}$=.00584	$\sqrt{u}$=.00009	$\sqrt{\lambda}$=.00293	$\sqrt{u}$=.00025	$\sqrt{\lambda}$=.00031	$\sqrt{u}$=.00083	$\sqrt{\lambda}$=.00024	$\sqrt{u}$=.00153	$\sqrt{\lambda}$=.00016	$\sqrt{u}$=.00128	$\sqrt{\lambda}$=.00259	$\sqrt{u}$=.00092	$\sqrt{\lambda}$=.00611	$\sqrt{u}$=.00030	$\sqrt{\lambda}$=.00599

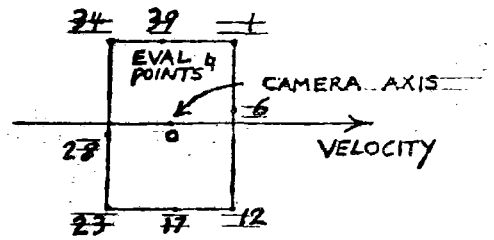
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	$\sqrt{u}$=.01955° .591 KM, $\sqrt{\lambda}$=.01845° .560 KM	$\sqrt{u}$=.03175° .960 KM, $\sqrt{\lambda}$=.02028° .611 KM	$\sqrt{u}$=.02083° .630 KM, $\sqrt{\lambda}$=.01354° .410 KM	$\sqrt{u}$=.01551° .470 KM, $\sqrt{\lambda}$=.01460° .442 KM	$\sqrt{u}$=.01533° .465 KM, $\sqrt{\lambda}$=.01948° .590 KM	$\sqrt{u}$=.01864° .565 KM, $\sqrt{\lambda}$=.02979° .903 KM	$\sqrt{u}$=.02226° .678 KM, $\sqrt{\lambda}$=.02755° .840 KM	$\sqrt{u}$=.03131° .950 KM, $\sqrt{\lambda}$=.03529° 1.07 KM	$\sqrt{u}$=.02932° .890 KM, $\sqrt{\lambda}$=.02658° .808 KM
NAVIGATION	$\sqrt{u}$=.01260	$\sqrt{\lambda}$=.00415	$\sqrt{u}$=.01177	$\sqrt{\lambda}$=.00501	$\sqrt{u}$=.01198	$\sqrt{\lambda}$=.00399	$\sqrt{u}$=.01215	$\sqrt{\lambda}$=.00310	$\sqrt{u}$=.01267	$\sqrt{\lambda}$=.00314	$\sqrt{u}$=.01365	$\sqrt{\lambda}$=.00320	$\sqrt{u}$=.01357	$\sqrt{\lambda}$=.00434	$\sqrt{u}$=.01344	$\sqrt{\lambda}$=.00637	$\sqrt{u}$=.01246	$\sqrt{\lambda}$=.00564
ATTITUDE	$\sqrt{u}$=.01483	$\sqrt{\lambda}$=.01776	$\sqrt{u}$=.02887	$\sqrt{\lambda}$=.01729	$\sqrt{u}$=.01637	$\sqrt{\lambda}$=.01267	$\sqrt{u}$=.00884	$\sqrt{\lambda}$=.01364	$\sqrt{u}$=.00840	$\sqrt{\lambda}$=.01883	$\sqrt{u}$=.01098	$\sqrt{\lambda}$=.02941	$\sqrt{u}$=.01656	$\sqrt{\lambda}$=.02704	$\sqrt{u}$=.02771	$\sqrt{\lambda}$=.03248	$\sqrt{u}$=.02648	$\sqrt{\lambda}$=.02370
CAMERA ON-TIME	$\sqrt{u}$=.00174	$\sqrt{\lambda}$=.00025	$\sqrt{u}$=.00166	$\sqrt{\lambda}$=.00035	$\sqrt{u}$=.00168	$\sqrt{\lambda}$=.00024	$\sqrt{u}$=.00169	$\sqrt{\lambda}$=.00011	$\sqrt{u}$=.00179	$\sqrt{\lambda}$=.00011	$\sqrt{u}$=.00185	$\sqrt{\lambda}$=.00010	$\sqrt{u}$=.00184	$\sqrt{\lambda}$=.00028	$\sqrt{u}$=.00183	$\sqrt{\lambda}$=.00053	$\sqrt{u}$=.00172	$\sqrt{\lambda}$=.00043
MOON RADIUS	$\sqrt{u}$=.00060	$\sqrt{\lambda}$=.00276	$\sqrt{u}$=.00575	$\sqrt{\lambda}$=.00833	$\sqrt{u}$=.00442	$\sqrt{\lambda}$=.00362	$\sqrt{u}$=.00249	$\sqrt{\lambda}$=.00420	$\sqrt{u}$=.00076	$\sqrt{\lambda}$=.00385	$\sqrt{u}$=.00610	$\sqrt{\lambda}$=.00349	$\sqrt{u}$=.00582	$\sqrt{\lambda}$=.00300	$\sqrt{u}$=.00531	$\sqrt{\lambda}$=.01223	$\sqrt{u}$=.00011	$\sqrt{\lambda}$=.01063

* u = LATITUDE λ = LONGITUDE

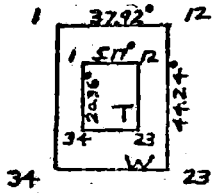
ERROR ANALYSIS RESULTS MISSION IV FRAME 170





S/C ALTITUDE = 1035 KM
TRUE ANOMALY = 354 °
INCLINATION ≈ 85 °
NOTE: APOLLO TGT $\bar{X}$ = 42A
R(35) P(-18°) Y(-75°)
to 4

4 EVAL POINT AND LENS ORIENTATION



TELEPHOTO LENS, T

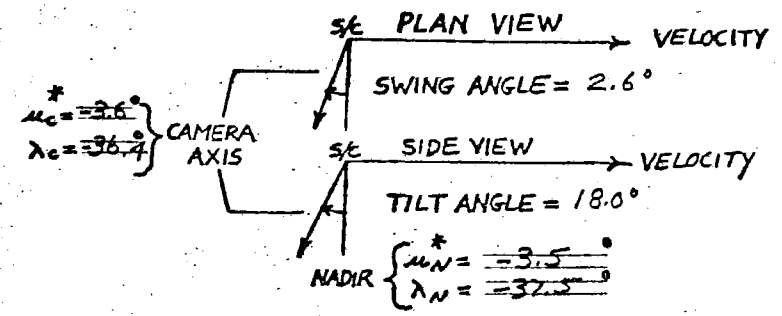
ERROR SOURCE	CAMERA AXIS (O)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .00829° .251 KM σ_λ = .00892° .270 KM	σ_μ = .01078° .326 KM σ_λ = .00996° .302 KM	σ_μ = .00850° .257 KM σ_λ = .00856° .260 KM	σ_μ = .00642° .194 KM σ_λ = .00832° .252 KM	σ_μ = .00645° .195 KM σ_λ = .00872° .264 KM	σ_μ = .00657° .199 KM σ_λ = .00924° .280 KM	σ_μ = .00817° .249 KM σ_λ = .00933° .282 KM	σ_μ = .01071° .325 KM σ_λ = .01082° .328 KM	σ_μ = .01071° .325 KM σ_λ = .01042° .316 KM
NAVIGATION	σ_μ = .00350 σ_λ = .00081	σ_μ = .00349 σ_λ = .00085	σ_μ = .00350 σ_λ = .00081	σ_μ = .00350 σ_λ = .00077	σ_μ = .00351 σ_λ = .00077	σ_μ = .00351 σ_λ = .00077	σ_μ = .00351 σ_λ = .00081	σ_μ = .00351 σ_λ = .00086	σ_μ = .00350 σ_λ = .00086
ATTITUDE	σ_μ = .00736 σ_λ = .00869	σ_μ = .01005 σ_λ = .00888	σ_μ = .00758 σ_λ = .00827	σ_μ = .00515 σ_λ = .00825	σ_μ = .00519 σ_λ = .00866	σ_μ = .00526 σ_λ = .00919	σ_μ = .00718 σ_λ = .00914	σ_μ = .01000 σ_λ = .00978	σ_μ = .01001 σ_λ = .00936
CAMERA ON-TIME	σ_μ = .00152 σ_λ = .00013	σ_μ = .00152 σ_λ = .00014	σ_μ = .00152 σ_λ = .00013	σ_μ = .00152 σ_λ = .00012	σ_μ = .00152 σ_λ = .00012	σ_μ = .00152 σ_λ = .00012	σ_μ = .00152 σ_λ = .00013	σ_μ = .00152 σ_λ = .00014	σ_μ = .00152 σ_λ = .00014
MOON RADIUS	σ_μ = .00005 σ_λ = .00186	σ_μ = .00081 σ_λ = .00443	σ_μ = .00060 σ_λ = .00204	σ_μ = .00036 σ_λ = .00067	σ_μ = .00020 σ_λ = .00062	σ_μ = .00087 σ_λ = .00057	σ_μ = .00070 σ_λ = .00169	σ_μ = .00049 σ_λ = .00455	σ_μ = .00011 σ_λ = .00449

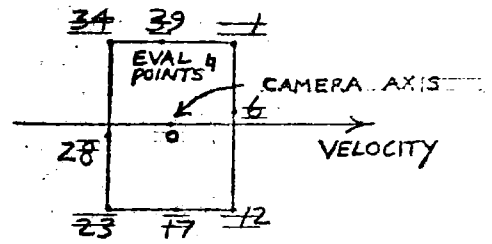
WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_μ = .00902° .273 KM σ_λ = .00924° .280 KM	σ_μ = .01804° .547 KM σ_λ = .01199° .363 KM	σ_μ = .01120° .340 KM σ_λ = .00716° .217 KM	σ_μ = .00709° .215 KM σ_λ = .00842° .255 KM	σ_μ = .00556° .169 KM σ_λ = .01025° .311 KM	σ_μ = .00830° .252 KM σ_λ = .01474° .447 KM	σ_μ = .01075° .326 KM σ_λ = .01334° .405 KM	σ_μ = .01617° .490 KM σ_λ = .01791° .543 KM	σ_μ = .01532° .465 KM σ_λ = .01452° .440 KM
NAVIGATION	σ_μ = .00350 σ_λ = .00081	σ_μ = .00348 σ_λ = .00090	σ_μ = .00348 σ_λ = .00081	σ_μ = .00348 σ_λ = .00073	σ_μ = .00350 σ_λ = .00072	σ_μ = .00359 σ_λ = .00072	σ_μ = .00359 σ_λ = .00081	σ_μ = .00358 σ_λ = .00097	σ_μ = .00350 σ_λ = .00093
ATTITUDE	σ_μ = .00817 σ_λ = .00901	σ_μ = .01671 σ_λ = .00919	σ_μ = .00937 σ_λ = .00684	σ_μ = .00438 σ_λ = .00738	σ_μ = .00404 σ_λ = .00956	σ_μ = .00523 σ_λ = .01435	σ_μ = .00871 σ_λ = .01319	σ_μ = .01495 σ_λ = .01564	σ_μ = .01483 σ_λ = .01200
CAMERA ON-TIME	σ_μ = .00152 σ_λ = .00013	σ_μ = .00152 σ_λ = .00013	σ_μ = .00152 σ_λ = .00013	σ_μ = .00152 σ_λ = .00012	σ_μ = .00152 σ_λ = .00011	σ_μ = .00154 σ_λ = .00011	σ_μ = .00154 σ_λ = .00013	σ_μ = .00154 σ_λ = .00017	σ_μ = .00152 σ_λ = .00015
MOON RADIUS	σ_μ = .00005 σ_λ = .00186	σ_μ = .00565 σ_λ = .00766	σ_μ = .00483 σ_λ = .00196	σ_μ = .00408 σ_λ = .00397	σ_μ = .00010 σ_λ = .00363	σ_μ = .00514 σ_λ = .00327	σ_μ = .00494 σ_λ = .00179	σ_μ = .00477 σ_λ = .00867	σ_μ = .00002 σ_λ = .00813

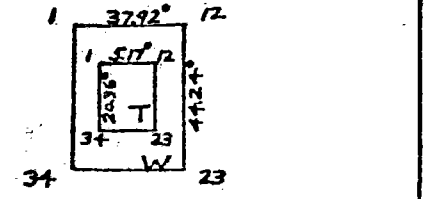
* μ = LATITUDE λ = LONGITUDE

ERROR ANALYSIS RESULTS MISSION V FRAME 174





S/C ALTITUDE = 103.4 KM
TRUE ANOMALY = 354. °
INCLINATION ≈ 85. °
NOTE: Apollo TGT = 42B
t4



TELEPHOTO LENS, T

ERROR SOURCE	CAMERA AXIS (0)	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .01103° (.334 KM) σ_λ = .01067° (.323 KM)	σ_u = .01283° (.339 KM) σ_λ = .00843° (.256 KM)	σ_u = .01107° (.335 KM) σ_λ = .00997° (.302 KM)	σ_u = .00930° (.282 KM) σ_λ = .01333° (.405 KM)	σ_u = .00944° (.286 KM) σ_λ = .01383° (.419 KM)	σ_u = .00971° (.294 KM) σ_λ = .01451° (.440 KM)	σ_u = .01109° (.336 KM) σ_λ = .01145° (.347 KM)	σ_u = .01305° (.396 KM) σ_λ = .00935° (.283 KM)	σ_u = .01292° (.392 KM) σ_λ = .00891° (.270 KM)
NAVIGATION	σ_u = .00716 σ_λ = .00096	σ_u = .00715 σ_λ = .00100	σ_u = .00715 σ_λ = .00097	σ_u = .00715 σ_λ = .00092	σ_u = .00716 σ_λ = .00091	σ_u = .00717 σ_λ = .00090	σ_u = .00717 σ_λ = .00095	σ_u = .00717 σ_λ = .00100	σ_u = .00716 σ_λ = .00100
ATTITUDE	σ_u = .00824 σ_λ = .00962	σ_u = .01055 σ_λ = .00814	σ_u = .00832 σ_λ = .00893	σ_u = .00574 σ_λ = .01091	σ_u = .00591 σ_λ = .01156	σ_u = .00620 σ_λ = .01239	σ_u = .00823 σ_λ = .01039	σ_u = .01076 σ_λ = .00911	σ_u = .01064 σ_λ = .00865
CAMERA ON-TIME	σ_u = .00152 σ_λ = .00011	σ_u = .00152 σ_λ = .00012	σ_u = .00152 σ_λ = .00011	σ_u = .00152 σ_λ = .00011	σ_u = .00152 σ_λ = .00010	σ_u = .00152 σ_λ = .00010	σ_u = .00152 σ_λ = .00011	σ_u = .00152 σ_λ = .00012	σ_u = .00152 σ_λ = .00012
MOON RADIUS	σ_u = .00054 σ_λ = .00452	σ_u = .00028 σ_λ = .00193	σ_u = .00014 σ_λ = .00431	σ_u = .00006 σ_λ = .00759	σ_u = .00070 σ_λ = .00755	σ_u = .00148 σ_λ = .00750	σ_u = .00123 σ_λ = .00473	σ_u = .00096 σ_λ = .00184	σ_u = .00039 σ_λ = .00188

WIDE-ANGLE LENS, W

ERROR SOURCE	CAMERA AXIS	EVAL POINT 1	EVAL POINT 6	EVAL POINT 12	EVAL POINT 17	EVAL POINT 23	EVAL POINT 28	EVAL POINT 34	EVAL POINT 39
TOTAL	σ_u = .01175° (.356 KM) σ_λ = .01100° (.333 KM)	σ_u = .01791° (.543 KM) σ_λ = .00678° (.205 KM)	σ_u = .01333° (.405 KM) σ_λ = .00851° (.258 KM)	σ_u = .01031° (.312 KM) σ_λ = .01773° (.537 KM)	σ_u = .00871° (.264 KM) σ_λ = .02043° (.620 KM)	σ_u = .01421° (.431 KM) σ_λ = .02906° (.880 KM)	σ_u = .01541° (.467 KM) σ_λ = .01688° (.511 KM)	σ_u = .01857° (.562 KM) σ_λ = .01214° (.369 KM)	σ_u = .01638° (.495 KM) σ_λ = .00898° (.272 KM)
NAVIGATION	σ_u = .00716 σ_λ = .00096	σ_u = .00714 σ_λ = .00104	σ_u = .00714 σ_λ = .00100	σ_u = .00716 σ_λ = .00098	σ_u = .00716 σ_λ = .00086	σ_u = .00735 σ_λ = .00074	σ_u = .00730 σ_λ = .00091	σ_u = .00726 σ_λ = .00108	σ_u = .00716 σ_λ = .00106
ATTITUDE	σ_u = .00918 σ_λ = .00998	σ_u = .01577 σ_λ = .00666	σ_u = .01022 σ_λ = .00723	σ_u = .00534 σ_λ = .01234	σ_u = .00469 σ_λ = .01634	σ_u = .00963 σ_λ = .02646	σ_u = .01219 σ_λ = .01617	σ_u = .01639 σ_λ = .01201	σ_u = .01465 σ_λ = .00885
CAMERA ON-TIME	σ_u = .00152 σ_λ = .00011	σ_u = .00152 σ_λ = .00013	σ_u = .00152 σ_λ = .00012	σ_u = .00152 σ_λ = .00012	σ_u = .00152 σ_λ = .00009	σ_u = .00156 σ_λ = .00005	σ_u = .00155 σ_λ = .00010	σ_u = .00154 σ_λ = .00013	σ_u = .00152 σ_λ = .00013
MOON RADIUS	σ_u = .00054 σ_λ = .00452	σ_u = .00432 σ_λ = .00068	σ_u = .00448 σ_λ = .00436	σ_u = .00493 σ_λ = .01269	σ_u = .00058 σ_λ = .01223	σ_u = .00726 σ_λ = .01199	σ_u = .00576 σ_λ = .00476	σ_u = .00459 σ_λ = .00139	σ_u = .00050 σ_λ = .00105

* μ = LATITUDE λ = LONGITUDE

5.0 TABULATION OF RESULTS, cont'd

5.3 References

1. TBC Document D2-100727-7 (Vol. VII), Lunar Orbiter I, Postmission Photo Supporting Data, 9/29/67.

2. TBC Document D2-100752-7 (Vol. VII), Lunar Orbiter II, Postmission Photo Supporting Data, 9/26/67.

3. TBC Document D2-100753-7 (Vol. VII), Lunar Orbiter III, Postmission Photo Supporting Data, 9/6/67.

4. TBC Document D2-100754-7 (Vol. VII), Lunar Orbiter IV, Postmission Photo Supporting Data, 9/21/67.

5. TBC Document D2-100755-7 (Vol. V), Lunar Orbiter V, Postmission Photo Supporting Data, 11/14/67.

6.0 DISCUSSION OF RESULTS

As discussed in the Summary Section, page 1, it is again noted that the errors in photo location and the overall error analysis described in this document do not account for uncertainties in the knowledge of the lunar gravitational model.

Examination of the results obtained is made on a mission-by-mission basis, although the interpretation thereof (in terms of error-governing parameters) will be common to all missions. The error-governing parameters determine the magnitude and location of errors obtained; they are spacecraft altitude, camera axis tilt angle (the angle between the camera axis and nadir), swing angle (showing the quadrant in which the tilt angle pertains, as indicated on the Error Analysis Results sheet of Section 5.0), number of attitude maneuvers following celestial alignment (for Mission IV frames), and to a lesser extent, the orbit inclination and spacecraft horizontal velocity.

It is noted that the photo error due to camera on-time error is negligible for all missions. Also, a large attitude maneuver tends to increase the attitude error, though the effect is subdued due to the relatively large camera axis-to-spacecraft alignment uncertainty.

For some frames either the nominal or one or more perturbation intercepts (due to the 11 EVAL Program primary errors) for a frame point will be off the moon, permitting no data (ND) to be presented for that point.

Mission I

Latitude and longitude errors for Apollo frames are noted to be less than 0.4 km for the telephoto (T) lens and less than 0.6 km for the wide-angle (W) lens, where the camera axis tilt angle is small (less than 20°). The errors are larger for the W than T lens because the misalignment of the camera axis in the spacecraft is slightly larger for the W lens, and because the larger field of view for W contributes to a larger error due to moon radius uncertainty for some points in the photo frame.

Errors in the neighborhood of 1 km result for Apollo Frame 137, having large tilt angle, the moon radius error being the primary contributor.

Generally speaking, the same results apply for frames having the same error-governing parameters. For frames taken at increased altitude (relative to an altitude of

6.0 DISCUSSION OF RESULTS, cont'd

approximately 50 km for Apollo frames), the attitude error becomes more significant, increasing the errors into the neighborhood of 0.3 - 3 km for 250 km altitude, and into the region of 4 - 40 km for 1300 - 1500 km altitude, depending upon the point examined in the frame. The attitude error actually predominates for frames taken at altitudes greater than approximately 210 km. For lower altitudes the total error is a combination of significant contributions from navigation and attitude error sources, with a significant variance for some points in the frame due to moon radius error.

Mission II

The Apollo frames have photo errors less than 0.3 km for the T lens and less than 0.5 km the lens W, for low camera axis tilt angles (less than 20^{o}). For large tilt angle the Apollo frame errors are increased into the neighborhood of 0.3 - 3 km.

The attitude error predominates for frames taken in the neighborhood of 1400 - 1600 km altitude, for which the photo errors are in the region of 3 - 20 km. For lower altitudes the total error is a combination of significant contributions from navigation and attitude error sources, with a significant variance for some points in the frame due to moon radius error.

Mission III

Apollo frames having low camera axis tilt angle (less than 20^{o}) exhibit errors less than 0.4 km for the T lens and less than 0.6 km for lens W, the exception being Frame 148, for which the errors are less than 0.6 km for the T lens and less than 1.2 km for the W lens (for a tilt angle of 8.4^{o}). For Apollo frames having large tilt angle, photo errors result in the neighborhood of 0.2 - 20 km.

Attitude error governs for Frame 37 (393 km altitude), giving photo errors in the neighborhood of 0.1 - 6 km, and for Frame 121 (1461 km altitude), resulting in photo errors in the region of 0.3 - 11 km. For lower altitudes the total error is a combination of significant contributions from navigation and attitude error sources, with a significant variance for some points in the frame due to moon radius error.

Mission IV

All frames are taken at high altitude for Mission IV (greater than 2600 km); atti-

6.0 DISCUSSION OF RESULTS, cont'd

tude errors predominate therefore in every case. With the exception of frames taken in the region of 6000 km altitude, most frames are taken in the neighborhood of 2800 km altitude, permitting Apollo and additional frames to be considered together in a discussion of photo errors.

A notable consideration for some frames is the increased attitude error generally accumulated due to a number of attitude maneuvers involved since (and including) the maneuver relative to celestial alignment. For five maneuvers, photo errors are in the neighborhood of 40 km and more; for a single maneuver, errors as low as a few km are obtained for some frame points. Nonlinearity is present in some of the larger errors (greater than 90 km), but the photo errors are given as an indication of the extensive uncertainty of some frame points. Many points are off the moon, permitting no data (ND) to be given.

Mission V

Apollo frames have photo errors less than 0.5 km for the T lens and less than 0.9 km for the W lens, for low camera axis tilt angle (less than 20^{o}). These errors are slightly larger than those for Missions I, II, and III, as the Apollo frames are taken at altitudes in the neighborhood of 100 km. For large tilt angles, the Apollo frame errors fall in the region of 0.2 - 30 km.

The attitude error predominates for frames taken at altitudes greater than 240 km. For altitudes below 240 km the total error is a combination of significant contributions from navigation and attitude error sources, with a significant variance for some points in the frame due to moon radius error.

For frames taken at altitudes in the neighborhood of 1300 - 3400 km, the photo errors vary widely in the region of 1 - 100 km.

Appendix A

Misalignment of Camera Axis in Spacecraft

Introduction:

Installation errors attend the mounting of the telephoto (T) and wide-angle (W) lenses in each spacecraft. Since the EVAL program accommodates camera pointing by the maneuver angles of roll, pitch, and yaw, it is necessary to ascertain maneuver angle errors equivalent to camera axis-to-spacecraft misalignment for each lens.

Equivalent Maneuver Angle Errors:

The nominal camera axis cone and clock angles are 110° and 90° respectively, measured in the spacecraft as indicated in Figure 1. The equivalent roll, pitch,

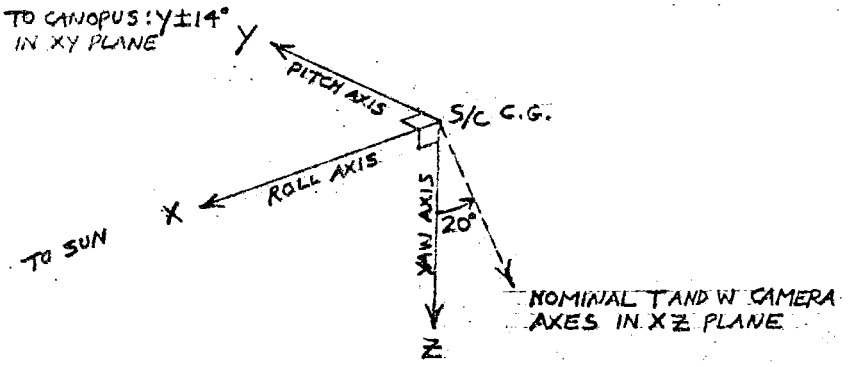


Figure 1, Nominal Mounting of Camera Axis in Spacecraft

and yaw errors are determined, for the telephoto lens, from the cone and clock mounting uncertainty of the telephoto lens with respect to the spacecraft, 0.3° for each, 3σ (laboratory data). The equivalent roll, pitch, and yaw errors are seen to be, respectively,

$$\text{T lens} \begin{cases} \sigma_{cam/sc_\phi} = \dfrac{0.3°/3}{\cos 20°} = 0.106° & (1) \\ \sigma_{cam/sc_\theta} = 0.3°/3 = 0.100° & (2) \\ \sigma_{cam/sc_\psi} = \dfrac{0.3°/3}{\sin 20°} = 0.293°, & (3) \end{cases}$$

where normal distributions have been assumed for the cone and clock mounting errors.

The equivalent maneuver angle errors for the wide-angle lens (W) are larger be-

Appendix A, cont'd

Equivalent Maneuver Angle Errors, cont'd

cause it is mounted relative to the telephoto lens. A study of T re W (=W re T) cone and clock uncertainties was made from photo data for Missions II, III, and IV (reference 1), yielding the results given in Figure 2.

ERROR \ MISSION	II	III	V
∇_{CONE} (°)	0.0186	0.0215	0.0274
∇_{CLOCK} (°)	0.0636	0.0606	0.0545

Figure 2, W re T Cone and Clock Errors

The relationships giving roll, pitch, and yaw errors for the W lens are

$$\text{W lens} \begin{cases} \nabla_{cam/sc_\phi} = \dfrac{\sqrt{(0.1)^2 + \nabla_{CLOCK}^2}}{\cos 20^\circ} & \text{degrees} \quad (4) \\ \nabla_{cam/sc_\theta} = \sqrt{(0.1)^2 + \nabla_{CONE}^2} & \text{degrees} \quad (5) \\ \nabla_{cam/sc_\psi} = \dfrac{\sqrt{(0.1)^2 + \nabla_{CLOCK}^2}}{\sin 20^\circ} & \text{degrees,} \quad (6) \end{cases}$$

giving the results listed in Figure 3; the error values employed for Missions I and IV are the worst case values of those for Missions II, III, and V.

	ERROR \ MISSION	I	II	III	IV	V
W lens	∇_{cam/sc_ϕ} (°)	0.127	0.127	0.125	0.127	0.121
	∇_{cam/sc_θ} (°)	0.104	0.102	0.102	0.104	0.104
	∇_{cam/sc_ψ} (°)	0.348	0.348	0.343	0.348	0.304

Figure 3, Roll, Pitch, and Yaw Errors Used for the Wide-Angle Lens, Using W re T Photo Data Uncertainty

References:

1. The Boeing Company Document D2-100814-1, Lunar Orbiter Photo Site Accuracy Analysis - Final Report - Photo Site Analysis.

Appendix B

Factors F_ϕ, F_θ, and F_ψ

Introduction:

The initial orientation error $\left[IO_{1 \text{ or } 2}\right]$ and execution errors $\left[EX_2\right]$ require adjustment to final attitude, as mentioned in Section 3.3. The adjustment, accomplished by factors F_ϕ, F_θ, and F_ψ (for the roll, pitch, and yaw maneuver angle errors, respectively) is necessary because

1. the maneuver angles are perturbed about final attitude (in obtaining sensitivities of photo parameters to maneuver angles), whereas
2. $\left[IO_{1 \text{ or } 2}\right]$ and $\left[EX_2\right]$ errors result according to the maneuver order: for a RPY maneuver (roll, pitch, yaw order), for example, the roll and pitch maneuver angle errors occur before final attitude is reached, so that an adjustment to final attitude is required.

Expressions for F_ϕ, F_θ, and F_ψ:

The adjustment to final attitude is made for R and P maneuver angle errors of an RPY maneuver, and for R and Y errors of an RYP maneuver; the adjustment is made by noting the camera axis orientation as the maneuver progresses:

1. for the R maneuver errors of an RPY maneuver, for example, referring to Figure 1, the angle α_1 between the initial camera axis orientation and the normal to the initial roll axis orientation is observed, along with the angle α_2 between the final camera axis orientation and the normal to the initial roll axis orientation.
2. Factor F_ϕ is then formed as the ratio of

$$F_\phi = \cos\alpha_2 / \cos\alpha_1 \qquad (1)$$

giving the error ratio (corresponding to final and initial camera axis positions) relative to the initial roll axis, where the errors have been generated. This factor will therefore adjust the roll error to final attitude.

The same procedure is carried out for the P axis of the RPY maneuver, and the R and Y axes of an RYP maneuver, taking the "initial" pitch and yaw maneuver axis positions in each case as the orientation resulting after the roll maneuver. Empirical expressions were deduced for each case by examination of Figure 1, the relationships for the factors being given in Figure 2, where Θ and Ψ denote pitch and yaw maneuver angles respectively. The RPY and RYP maneuver orders

Appendix B, cont'd

Expressions for F_ϕ, F_θ, and F_ψ, cont'd

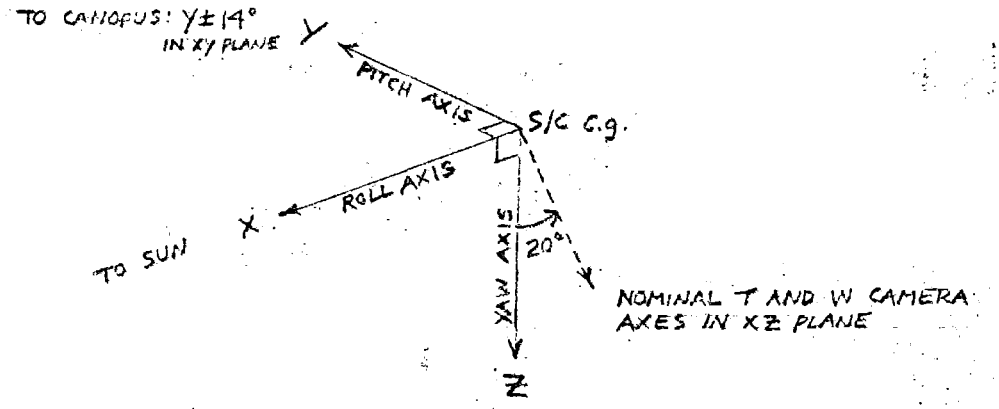


Figure 1, Nominal Mounting of Camera Axis in Spacecraft

	RPY Maneuver	RYP Maneuver
F_ϕ =	$\frac{\lvert\cos(\theta + 20^\circ\cos\Psi)\rvert}{\cos 20^\circ}$	$\frac{\lvert\cos(20^\circ + \theta\cos\Psi)\rvert}{\cos 20^\circ}$
F_θ =	$\cos(20^\circ \sin\Psi)$	1
F_ψ =	1	$\frac{\lvert\sin(20^\circ + \theta)\rvert}{\sin 20^\circ}$

Figure 2, Expressions for F_ϕ, F_θ, and F_ψ, Roll, Pitch, and Yaw Error Factors, Respectively

only are required as other maneuver orders, such as the PYP maneuver of Mission IV, frame 10, are synthesized from two maneuvers, (R)PY, (R)P(Y), of this type (where the maneuvers in paranthesis are set equal to zero.

Tabulation of Factors for Each Mission:

Mission I

Apollo Frames	F_ϕ	F_θ	F_ψ	Apollo Frames	F_ϕ	F_θ	F_ψ
F 59	1.05	1.00	.530	F175	1.00	1.00	1.00
F 92	1.00	1.00	.923	F179	1.04	1.00	.439
F125	1.00	1.00	.888	F191	1.05	1.00	.661
F137	1.03	1.00	1.00	F207	1.05	1.00	.603
F164	1.05	1.00	.362				

Appendix B, cont'd

Tabulation of Factors for Each Mission, cont'd

Mission I

Additional Frames	F_ϕ	F_θ	F_ψ	Additional Frames	F_ϕ	F_θ	F_ψ
F 12	1.04	1.00	.603	F116	1.00	1.00	1.00
F 28	1.00	1.00	1.00	F135	1.00	1.00	1.00
F 32	1.00	1.00	1.00	F139	1.00	1.00	1.00
F 42	1.00	1.00	1.00	F150	1.00	1.00	1.00
F 46	1.00	1.00	1.00	F154	1.00	1.00	1.00
F 75	1.03	1.00	.764	F173	1.00	1.00	1.00
F 84	1.00	1.00	1.00	F174	1.00	1.00	1.00
F103	1.00	1.00	1.00				

Mission II

Apollo Frames	F_ϕ	F_θ	F_ψ	Apollo Frames	F_ϕ	F_θ	F_ψ
F 38	1.00	1.00	.883	F132	1.04	1.00	.497
F 79	1.04	1.00	.620	F137	.910	1.00	1.53
F 87	1.04	1.00	.546	F166	1.04	1.00	.635
F 93	.964	1.00	1.00	F174	1.04	1.00	.561
F116	1.04	1.00	.650	F200	1.00	1.00	1.01
F124	1.04	1.00	.574	F208	1.00	1.00	1.00

Mission II

Additional Frames	F_ϕ	F_θ	F_ψ	Additional Frames	F_ϕ	F_θ	F_ψ
F 22	.981	1.00	1.14	F 99	1.00	1.00	1.00
F 26	.913	1.00	1.51	F141	1.03	1.00	.795
F 33	1.00	1.00	1.00	F162	.950	.989	1.00
F 34	1.00	1.00	1.00	F196	1.00	1.00	1.00
F 62	.945	1.00	1.35	F214	.945	1.00	1.36
F 75	1.00	1.00	1.00	F215	.763	.996	1.00

Mission III

Apollo Frames	F_ϕ	F_θ	F_ψ	Apollo Frames	F_ϕ	F_θ	F_ψ
F 12	.988	1.00	1.19	F148	1.03	1.00	.770
F 28	1.03	1.00	.737	F156	1.02	1.00	.853
F 34	.994	1.00	1.06	F161	.878	1.00	1.00
F 55	1.01	1.00	.854	F166	.893	1.00	1.63
F 63	.981	1.00	1.15	F171	.663	1.00	1.00
F 72	.985	.989	1.00	F172	.631	1.00	1.00
F 89	1.01	1.00	.951	F176	1.02	1.00	.822
F 97	.997	1.00	1.00	F182	1.02	1.00	.850
F120	.870	1.00	1.00	F192	1.01	1.00	.868
F136	.895	1.00	1.00	F202	1.01	1.00	.880
F140	1.04	1.00	.617	F208	.924	1.00	1.52

Appendix B, cont'd

Tabulation of Factors for Each Mission, cont'd

Mission III

Additional Frames	F_ϕ	F_θ	F_ψ	Additional Frames	F_ϕ	F_θ	F_ψ
F 22	.975	1.00	1.19	F 75	.923	1.00	1.48
F 37	.870	1.00	1.68	F 78	.950	.995	1.00
F 38	1.05	1.00	.477	F 81	1.01	1.00	.900
F 39	.870	1.00	1.00	F102	.930	.991	1.00
F 41	.980	1.00	1.15	F121	1.00	1.00	1.00
F 47	.994	1.00	1.05	F213	.993	1.00	.940
F 69	1.01	1.00	.924	F215	.902	1.00	1.58
F 73	.708	.992	1.00				

Mission IV

Apollo Frames	F_ϕ	F_θ	F_ψ	Apollo Frames	F_ϕ	F_θ	F_ψ
(F 64)*	.931	1.00	1.41	(F106)	.851	.990	1.00
F 65	1.06	1.00	1.00	(F107)	1.01	.981	1.00
F 66	1.02	1.00	1.00	F108	1.06	1.00	1.00
(F 70A)	1.04	1.00	.541	F109	1.02	1.00	1.00
(F 70B)	1.00	1.00	1.00	(F118)	.844	.991	1.00
(F 71)	1.01	.981	1.00	(F119)	1.01	.981	1.00
(F 72)	1.06	1.00	1.00	F120	1.06	1.00	1.00
F 73	1.02	1.00	1.00	F121	1.02	1.00	1.00
(F 82)	.862	.989	1.00	(F124)	.900	1.00	1.56
(F 83)	1.01	.981	1.00	F125	1.06	1.00	1.00
F 84	1.06	1.00	1.00	(F136)	.892	1.00	1.60
F 85	1.02	1.00	1.00	F137	1.06	1.00	1.00
(F100)	.913	1.00	1.50	(F142A)	.810	1.00	1.96
F101	1.06	1.00	1.00	(F142B)	1.01	.979	1.00
F102	1.02	1.00	1.00	F143	1.06	1.00	1.00
				F144	1.02	1.00	1.00

Mission IV

Additional Frames	F_ϕ	F_θ	F_ψ	Additional Frames	F_ϕ	F_θ	F_ψ
F 6	.887	.987	1.00	(F 38)	.943	1.00	1.35
F 10A	1.00	1.00	1.00	(F 39)	1.06	1.00	1.00
F 10B	1.00	1.00	.792	(F 40)	1.02	1.00	1.00
F 14	1.06	1.00	1.00	(F 41)	.960	1.00	1.00
F 18	1.06	1.00	1.00	F 42	.984	.990	1.00
F 22	.960	1.00	1.00	F 75	.450	1.00	1.00
F 25	.450	1.00	1.00	(F 142A)	.810	1.00	1.96
(F 26)	.950	1.00	1.32	F 142B	1.01	.979	1.00
(F 27)	1.06	1.00	1.00	F 146	.568	1.00	2.53
(F 28)	1.02	1.00	1.00	F 154	.782	1.00	2.04
(F 29)	.960	1.00	1.00	F 165	.547	1.00	1.00
F 30	.985	.990	1.00	F 178	.499	1.00	1.00

* Frames in parentheses signify frames(with associated maneuvers) involved between celestial alignment and frames of interest(not parenthesized).

Appendix B, cont'd

Tabulation of Factors for Each Mission, cont'd

Mission V

Apollo Frames	F_ϕ	F_θ	F_ψ	Apollo Frames	F_ϕ	F_θ	F_ψ
F 38	.725	1.00	2.16	F 64	.759	1.00	2.17
F 42	.759	1.00	2.16	F 72	1.03	.943	1.00
F 45	1.02	.944	1.00	F 76	1.06	.940	1.00
F 49	1.06	.940	1.00	F109	1.01	.944	1.00
F 52	.744	1.00	2.20	F113	1.06	.940	1.00
F 56	1.00	.944	1.00	F170	1.04	.944	1.00
F 60	1.06	.940	1.00	F174	1.06	.940	1.00

Mission V

Additional Frames	F_ϕ	F_θ	F_ψ	Additional Frames	F_ϕ	F_θ	F_ψ
F 21	1.05	1.00	1.00	F 63	1.04	.940	1.00
F 22	1.06	1.00	1.00	F 91	.973	.942	1.00
F 29	.981	1.00	1.00	F102	.400	1.00	2.89
F 32	1.06	1.00	1.00	F103	1.06	1.00	1.00
F 34	1.06	.946	1.00	F117	1.06	.942	1.00
F 37	1.05	.948	1.00	F130	1.03	.940	1.00
F 41	.804	1.00	1.98	F168	1.06	.947	1.00
F 54	.821	1.00	2.29				

Appendix C

Compilation of Maneuver Input Data Sheets

Introduction:

A maneuver data sheet is a required input to the error analysis study for each frame examined (including Mission IV frames corresponding to celestial alignment, up to and inclusive of the frame of interest). The maneuver data sheet tabulates 3σ maneuver angle (roll, pitch, and yaw) errors due to data reduction (DR, uncertainty resulting in locating dead-band position from known data points), limit-cycle position errors due to telemetry error ($LS_{T/L}$), and rate-integrating-mode uncertainties (RIM). Also tabulated are maneuver parameters (maneuver order, magnitudes, and durations) required to compute other maneuver angle errors given in Section 3.3.

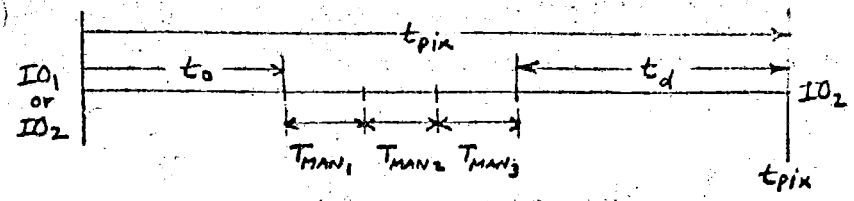
The data reduction and telemetry errors are combined (root-sum-squared) into a single input error by the maneuver analysis program W. DERVISH which obtains them; this is valid as they are so combined in the error analysis. The RIM error for a given maneuver axis includes the total drift uncertainty from celestial alignment to picture time (or previous orientation to picture time for each frame in a Mission IV sequence), subtracting the maneuver duration time T_{MAN} for that axis.

In some cases the data reduction error is unsymmetrical due to attitude position near one side of the dead band for a given maneuver axis. In such cases, negligible error is introduced by forming symmetrical bounds according to the largest deviation, because all other errors are symmetrical, including the predominating camera-axis-to-spacecraft alignment error.

Maneuver Data Sheets:

A maneuver data sheet for each frame of interest is attached.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 12

MAN. ORDER RYP

MAN. ANGLES° 3.85
12.45
-8.10

ROLL

$DR_\phi = \pm .0283°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0175°$

$T_{MAN_\phi} = 10.94$ sec.

PITCH

$DR_\theta = \pm .0619°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00492°$

$T_{MAN_\theta} = 18.36$ sec

YAW

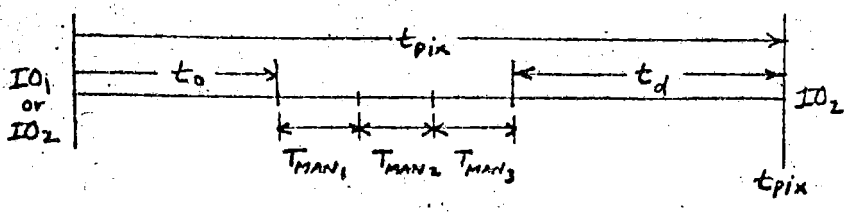
$DR_\psi = \pm .0593°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00271°$

$T_{MAN_\psi} = 27.35$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 28

MAN. ORDER RPY

MAN. ANGLES° -17.65

0

0

ROLL

$DR_\phi = \pm .0372°$ ~~.0215°~~

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .1039°$

$T_{MAN_\phi} = 363.18$ sec.

PITCH

$DR_\theta = \pm .0563°$ ~~.2044°~~

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.1196°$

$T_{MAN_\theta} = 0.$ sec

YAW

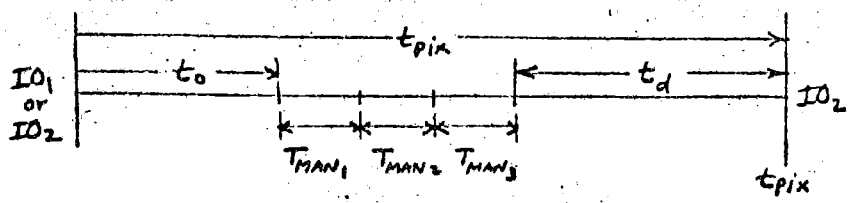
$DR_\psi = \pm .0573°$ ~~.2004°~~

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.6836°$

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 32

MAN. ORDER RPY

MAN. ANGLES° 0.5 / 0 / 0

ROLL

$DR_\phi = \pm .0423°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .013°$

$T_{MAN_\phi} = 0.$ sec.

PITCH

$DR_\theta = \pm .051°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.$ °

$T_{MAN_\theta} = 0.$ sec

YAW

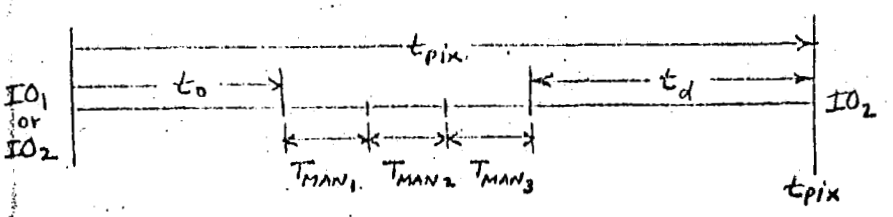
$DR_\psi = \pm .051°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.$ °

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☒ IO_2 ☐

MISSION I

FRAME 42

MAN. ORDER R P Y

MAN. ANGLES 2.4

0

0

ROLL

$DR_\phi = \pm .0423°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .158°$

$T_{MAN_\phi} = 0.$ sec.

PITCH

$DR_\theta = \pm .051°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0$ °

$T_{MAN_\theta} = 0.$ sec

YAW

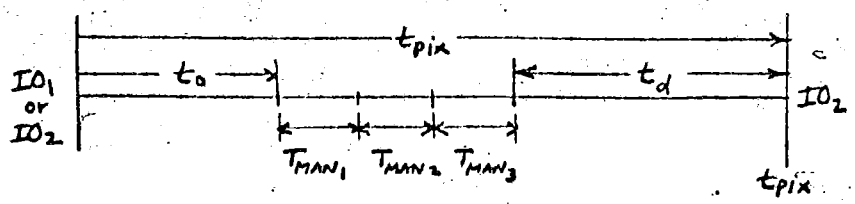
$DR_\psi = \pm .051°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0$ °

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 46

MAN. ORDER R P Y

MAN. ANGLES −2.6

0

0

ROLL

$DR_\phi = \pm .042$ °

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .010$ °

$T_{MAN_\phi} = 0.$ sec.

PITCH

$DR_\theta = \pm .051$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0$ °

$T_{MAN_\theta} = 0.$ sec

YAW

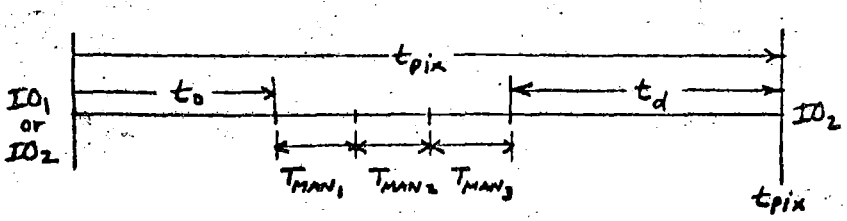
$DR_\psi = \pm .051$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0$ °

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 59

MAN. ORDER RVP

MAN. ANGLES° 5.43

12.46

-9.60

ROLL

$DR_\phi = \pm .0333°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0471°$

$T_{MAN_\phi} = 19.50$ sec.

PITCH

$DR_\theta = \pm .0783°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0309°$

$T_{MAN_\theta} = 21.40$ sec

YAW

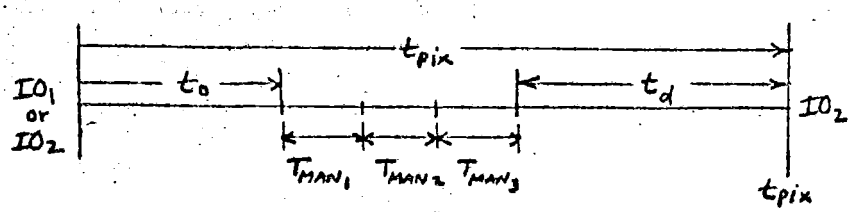
$DR_\psi = \pm .0241°$ $\pm .0740$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0304°$

$T_{MAN_\psi} = 27.38$ sec.

MANEUVER DATA SHEET



IO_1 ☒ IO_2 ☐

MISSION I

FRAME 75

MAN. ORDER RVP

MAN. ANGLES 5.93
12.48
-4.98

ROLL

$DR_\phi = \pm .0423°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0039°$

$T_{MAN_\phi} = 19.66$ sec.

PITCH

$DR_\theta = \pm .0828°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00210°$

$T_{MAN_\theta} = 12.16$ sec

YAW

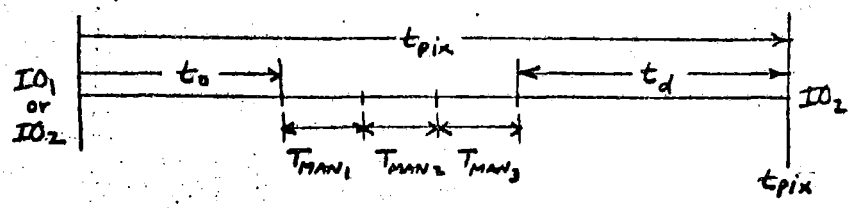
$DR_\psi = \pm$ $^{+.0219}_{-.0572}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00197°$

$T_{MAN_\psi} = 27.42$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 84

MAN. ORDER R P Y

MAN. ANGLES [illegible]

[illegible]

[illegible]

ROLL

$DR_\phi = \pm .042°$

$LS_{T/L_\phi} = \pm$ [illegible]°

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .010°$

$T_{MAN_\phi} = .0$ [illegible] sec.

PITCH

$DR_\theta = \pm .051°$

$LS_{T/L_\theta} = \pm$ [illegible]°

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0$ [illegible]°

$T_{MAN_\theta} = .0$ [illegible] sec

YAW

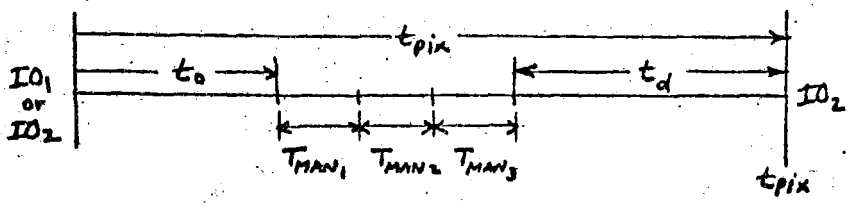
$DR_\psi = \pm .051°$

$LS_{T/L_\psi} = \pm$ [illegible]°

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0$ [illegible]°

$T_{MAN_\psi} = .00$ [illegible] sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 92

MAN. ORDER RYP

MAN. ANGLES° 5.95
12.60
−1.60

ROLL

$DR_\phi = \pm .0356°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00650°$

$T_{MAN_\phi} = 15.73$ sec.

PITCH

$DR_\theta = \pm .0531°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00149°$

$T_{MAN_\theta} = 5.34$ sec

YAW

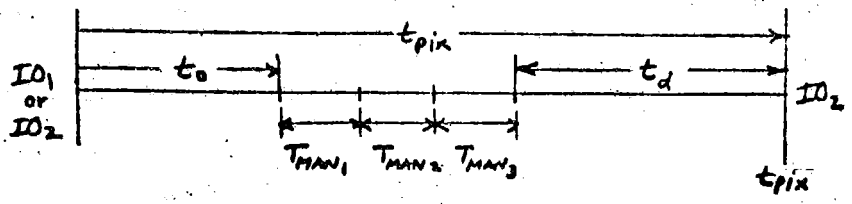
$DR_\psi = \pm .0418°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00204°$

$T_{MAN_\psi} = 27.64$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 103

MAN. ORDER RPY

MAN. ANGLES -1.5

0.

0.

ROLL

$DR_\phi = \pm .0423°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .010°$

$T_{MAN_\phi} = .0$ sec

PITCH

$DR_\theta = \pm .051°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0°$

$T_{MAN_\theta} = .0$ sec

YAW

$DR_\psi = \pm .051°$

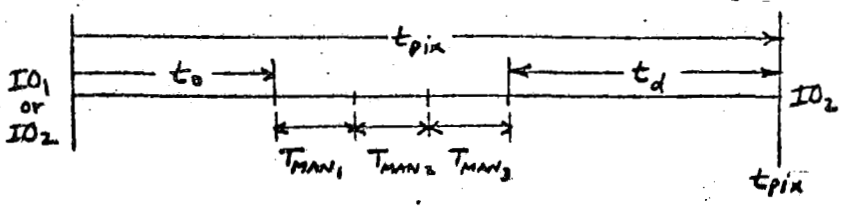
$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0°$

$T_{MAN_\psi} = .0$ sec.

103

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 116

MAN. ORDER RPY

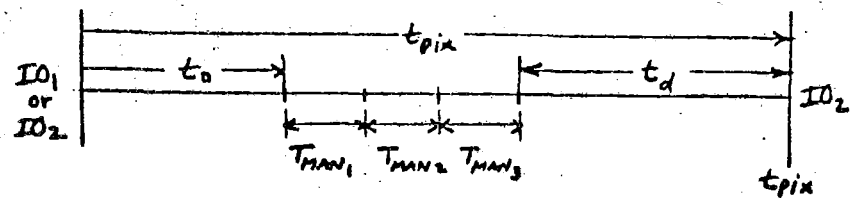
MAN. ANGLES 180

0

0

ROLL	PITCH	YAW
$DR_\phi = \pm .0356°$	$DR_\theta = \pm .0676°$	$DR_\psi = \pm .0687°$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0287°$	$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.$ °	$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.$ °
$T_{MAN_\phi} = 356.47$ sec.	$T_{MAN_\theta} = 0.$ sec	$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 125

MAN. ORDER R Y P

MAN. ANGLES° 6.50
12.60
-2.30

ROLL

$DR_\phi = \pm .0438°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0388°$

$T_{MAN_\phi} = 16.79$ sec.

PITCH

$DR_\theta = \pm .0678°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00070°$

$T_{MAN_\theta} = 8.17$ sec

YAW

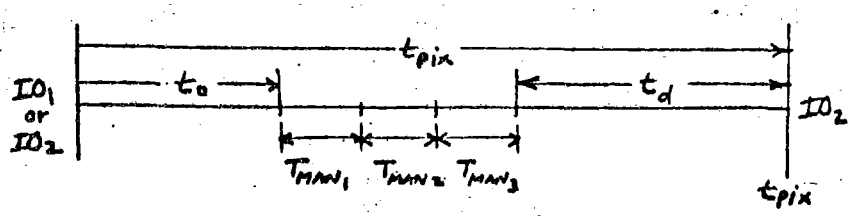
$DR_\psi = \pm .0696°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00065°$

$T_{MAN_\psi} = 26.69$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 135

MAN. ORDER RPY

MAN. ANGLES -2.15

0

0

ROLL

$DR_\phi = \pm .0423°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .011$ °

$T_{MAN_\phi} = .0$ sec.

PITCH

$DR_\theta = \pm .051°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0$ °

$T_{MAN_\theta} = .0$ sec

YAW

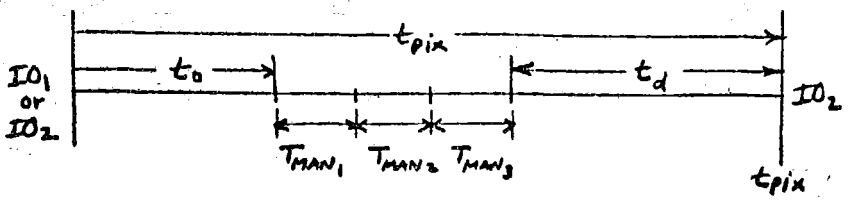
$DR_\psi = \pm .051°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0$ °

$T_{MAN_\psi} = .0$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 137

MAN. ORDER R P Y

MAN. ANGLES° 0.4

-35.7

1.5°

ROLL

$\begin{cases} DR_\phi = \pm .0389^\circ \\ LS_{T/L_\phi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0401^\circ$

$T_{MAN_\phi} = 0.$ sec.

PITCH

$\begin{cases} DR_\theta = \pm .0343^\circ \\ LS_{T/L_\theta} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00687^\circ$

$T_{MAN_\theta} = 74.20$ sec

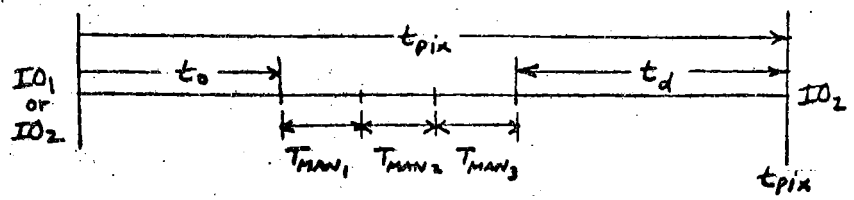
YAW

$\begin{cases} DR_\psi = \pm .0393^\circ \\ LS_{T/L_\psi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0425^\circ$

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 139

MAN. ORDER R P Y

MAN. ANGLES -L

-O

O

ROLL

$DR_\phi = \pm .04°23$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .010$ °

$T_{MAN_\phi} = .0$ sec

PITCH

$DR_\theta = \pm .05°1$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0$ °

$T_{MAN_\theta} = .0$ sec

YAW

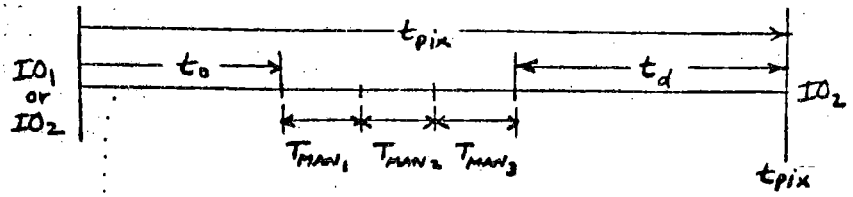
$DR_\psi = \pm .05°1$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0$ °

$T_{MAN_\psi} = .0$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION J

FRAME 1350

MAN. ORDER RPY

MAN. ANGLES 1.3

0.

0.

ROLL

$DR_\phi = \pm .0370°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0632°$

$T_{MAN_\phi} = 12.79$ sec.

PITCH

$DR_\theta = \pm$ $^{+.0125}_{-.4}$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0070°$

$T_{MAN_\theta} = 0.$ sec

YAW

$DR_\psi = \pm$ $^{+.0179}_{-.4}$ °

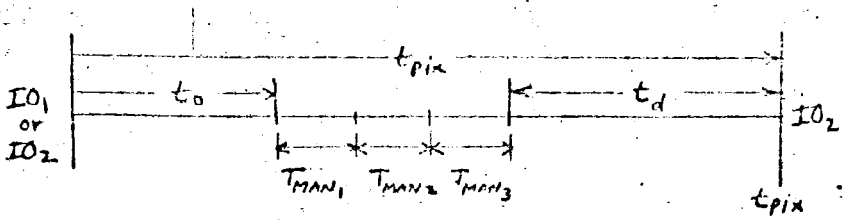
$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0122°$

$T_{MAN_\psi} = 0.$ sec.

1350

MANEUVER DATA SHEET



IO_1 ☒ IO_2 ☐

MISSION I

FRAME 154

MAN. ORDER RPY

MAN. ANGLES 140

0

0

ROLL

$DR_\phi = \pm .0321°$

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .1363°$

$T_{MAN_\phi} = 13.80$ sec

PITCH

$DR_\theta = \pm .0459°$

$LS_{T/L_\theta} = \pm$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00207°$

$T_{MAN_\theta} = 0.$ sec

YAW

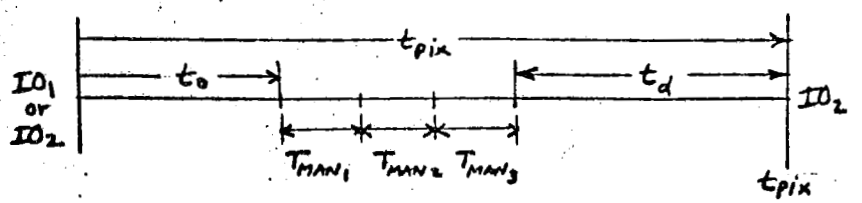
$DR_\psi = \pm .0456°$

$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0245°$

$T_{MAN_\psi} = 0.$ sec

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 164

MAN. ORDER RYP

MAN. ANGLES° 7.56

12.80

-12.90

ROLL

$DR_\phi = \pm .0323°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00497°$

$T_{MAN_\phi} = 18.99$ sec.

PITCH

$DR_\theta = \pm .0521°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00078°$

$T_{MAN_\theta} = 27.91$ sec

YAW

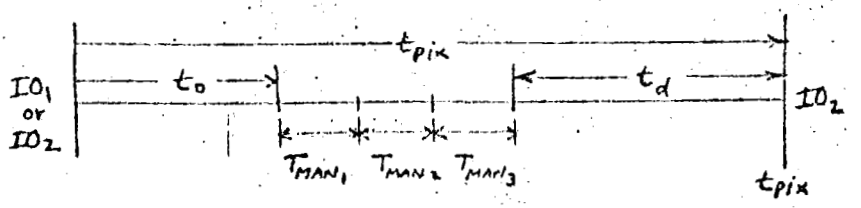
$DR_\psi = \pm .0409°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00936°$

$T_{MAN_\psi} = 27.97$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 173

MAN. ORDER RPY

MAN. ANGLES -3.20

20

0

ROLL

$DR_\phi = \pm .0473°$

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0044°$

$T_{MAN_\phi} = 15:18$ sec

PITCH

$DR_\theta = \pm .0734°$

$LS_{T/L_\theta} = \pm$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.$

$T_{MAN_\theta} = 0.$ sec

YAW

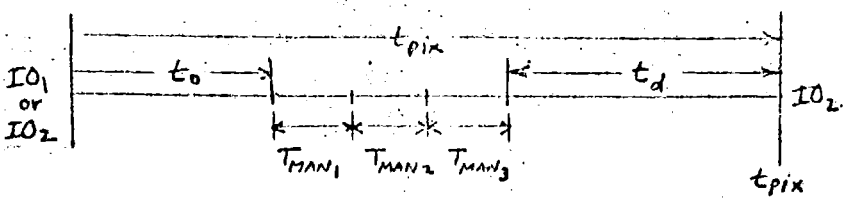
$DR_\psi = \pm .0741°$

$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.$

$T_{MAN_\psi} = 0.$ sec

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I.

FRAME 174

MAN. ORDER RPY

MAN. ANGLES −1.80

0

0

ROLL

$DR_\phi = \pm .0396°$

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00197°$

$T_{MAN_\phi} = 10.83$ sec.

PITCH

$DR_\theta = \pm .0339°$

$LS_{T/L_\theta} = \pm$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.°$

$T_{MAN_\theta} = 0.$ sec

YAW

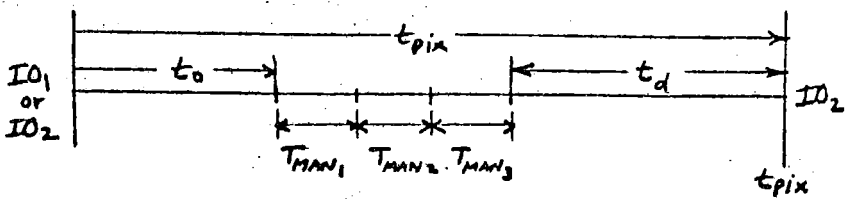
$DR_\psi = \pm .0358°$

$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.°$

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☒ IO_2 ☐

MISSION I

FRAME 175

MAN. ORDER R P Y

MAN. ANGLES° -2.5

0

0

ROLL

$DR_\phi = \pm .042°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .010°$

$T_{MAN_\phi} = 0.$ sec.

PITCH

$DR_\theta = \pm .051°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.$ °

$T_{MAN_\theta} = 0.$ sec.

YAW

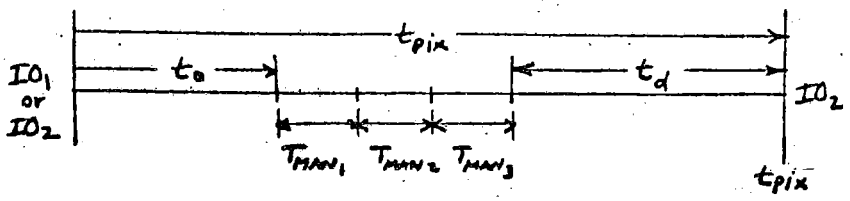
$DR_\psi = \pm .051°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.$ °

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 179

MAN. ORDER RYP

MAN. ANGLES 8.49
12.81
−11.33

ROLL

$DR_\phi = \pm .0404°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0373°$

$T_{MAN_\phi} = 19.87$ sec.

PITCH

$DR_\theta = \pm .0649°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00073°$

$T_{MAN_\theta} = 24.85$ sec.

YAW

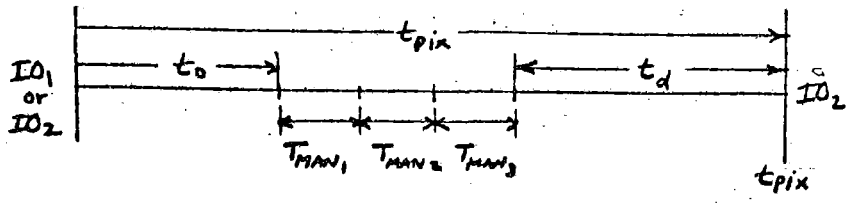
$DR_\psi = \pm$ 0.1° $+.0200$ $-.0618$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00652°$

$T_{MAN_\psi} = 28.08$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 191

MAN. ORDER R V P

MAN. ANGLES° 8.13

12.81

-6.86

ROLL

$DR_\phi = \pm .0298°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0140°$

$T_{MAN_\phi} = 20.00$ sec.

PITCH

$DR_\theta = \pm .0462°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00074°$

$T_{MAN_\theta} = 15.92$ sec

YAW

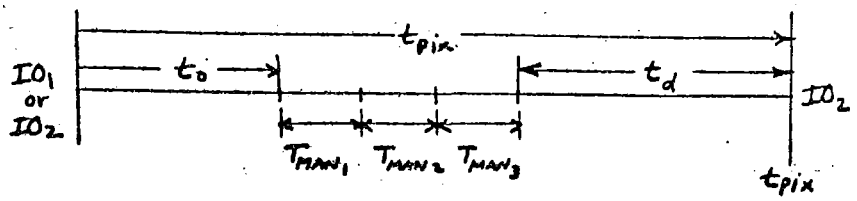
$DR_\psi = \pm .0361°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00496°$

$T_{MAN_\psi} = 28.08$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION I

FRAME 257

MAN. ORDER RYP

MAN. ANGLES° 9.15

12.30

-8.30

ROLL

$DR_\phi = \pm .0330°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0217°$

$T_{MAN_\phi} = 20.18$ sec.

PITCH

$DR_\theta = \pm .0565°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00375°$

$T_{MAN_\theta} = 18.85$ sec

YAW

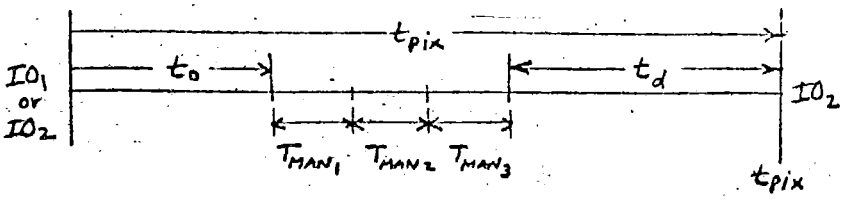
$DR_\psi = \pm .0446°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00308°$

$T_{MAN_\psi} = 28.10$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 22

MAN. ORDER R/Y/P

MAN. ANGLES° 5.24
9.25
2.81

ROLL

$\begin{cases} DR_\phi = \pm .0290^\circ \\ LS_{T/L_\phi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .000846^\circ$

$T_{MAN_\phi} = 14.211$ sec.

PITCH

$\begin{cases} DR_\theta = \pm .0252^\circ \\ LS_{T/L_\theta} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .000276^\circ$

$T_{MAN_\theta} = 7.703$ sec

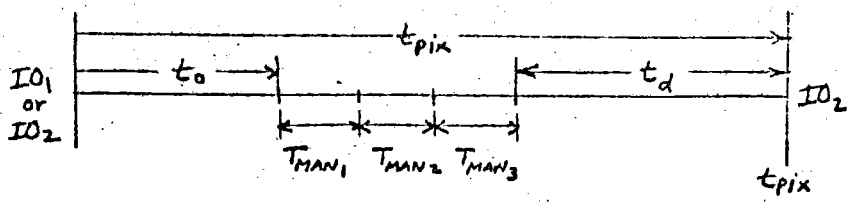
YAW

$\begin{cases} DR_\psi = \pm .^\circ \\ LS_{T/L_\psi} = \pm \quad ^\circ \end{cases}$ $+.0125$ $-.0936$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .000241^\circ$

$T_{MAN_\psi} = 20.836$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 226

MAN. ORDER R Y P

MAN. ANGLES° -1.47

6.93

11.12

ROLL

$DR_\phi = \pm .0219°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00119°$

$T_{MAN_\phi} = 6.624$ sec

PITCH

$DR_\theta = \pm .0781$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .000196°$

$T_{MAN_\theta} = 24.323$ sec

YAW

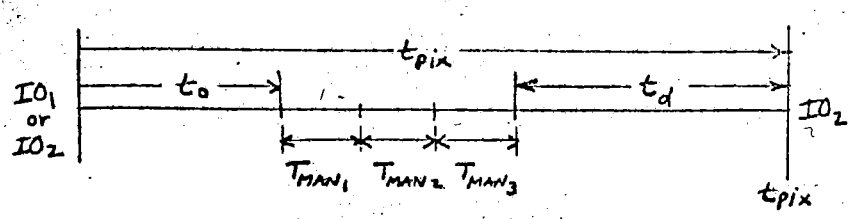
$DR_\psi = \pm$ $^{+.0125}_{-.1196}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .000192°$

$T_{MAN_\psi} = 16.196$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 33

MAN. ORDER RYP

MAN. ANGLES ° -17.8
0
0.

f/c Behind Moon

ROLL

$DR_\phi = \pm .283°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .013°$

$T_{MAN_\phi} = 359.72$ sec.

PITCH

$DR_\theta = \pm .200°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} =$ 0. sec

YAW

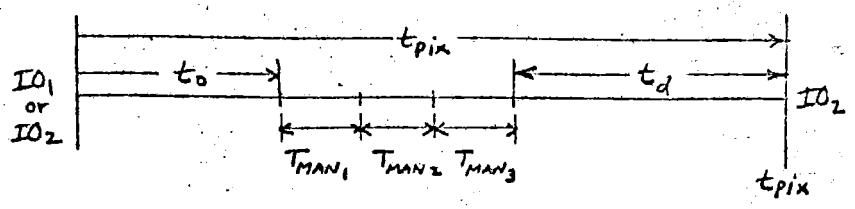
$DR_\psi = \pm .200°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} =$ 0. sec.

MANEUVER DATA SHEET



IO1 ☑ IO2 ☐

MISSION II

FRAME 34

MAN. ORDER R/P

MAN. ANGLES° 104.0

0.

0.

S/C Behind Moon.

ROLL

$DR_\phi = \pm .283$ °

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .013$°

$T_{MAN_\phi} = 33172$ sec.

PITCH

$DR_\theta = \pm .200$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} =$ 0. sec

YAW

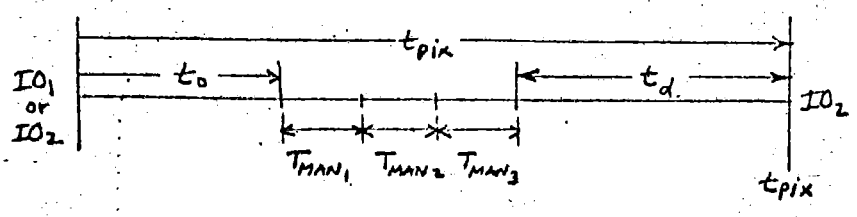
$DR_\psi = \pm .200$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} =$ 0. sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 38

MAN. ORDER P V P

MAN. ANGLES ° 5.30

9.5

-2.4

ROLL

$\begin{cases} DR_\phi = \pm .0282^\circ \\ LS_{T/L_\phi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .000177^\circ$

$T_{MAN_\phi} = 14.331$ sec.

PITCH

$\begin{cases} DR_\theta = \pm \quad ^\circ \\ LS_{T/L_\theta} = \pm \begin{matrix} \pm .0127 \\ .0363 \end{matrix} \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm \quad 0. \quad ^\circ$

$T_{MAN_\theta} = 6.883$ sec

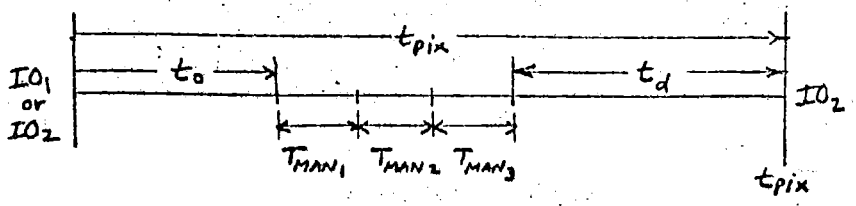
YAW

$\begin{cases} DR_\psi = \pm .0125^\circ \\ LS_{T/L_\psi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm \quad 0. \quad ^\circ$

$T_{MAN_\psi} = 21.336$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 62

MAN. ORDER RYP

MAN. ANGLES° 5.33
9.57
7.61

ROLL

$DR_\phi = \pm .0341°$

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm$ 0.°

$T_{MAN_\phi} = 14.391$ sec.

PITCH

$DR_\theta = \pm$ $\pm .0406$ $\pm .0548$ °

$LS_{T/L_\theta} = \pm$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 17.303$ sec

YAW

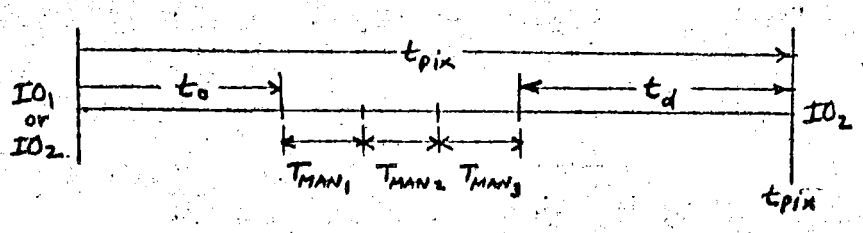
$DR_\psi = \pm .0453°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 22.476$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 75

MAN. ORDER R Y P

MAN. ANGLES ° -165.0

0.

-0-

ROLL

$DR_\phi = \pm .283$ °

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .013$ °

$T_{MAN_\phi} = 333.72$ sec.

PITCH

$DR_\theta = \pm .200$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0$ °

$T_{MAN_\theta} = 0$ sec

YAW

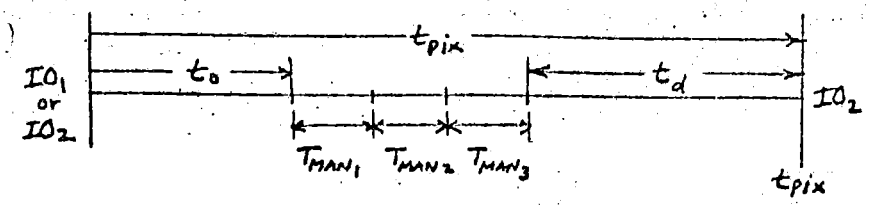
$DR_\psi = \pm .200$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0$ °

$T_{MAN_\psi} = 0$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 79

MAN. ORDER R Y P

MAN. ANGLES° 5.39

9.62

-7.74

ROLL

$DR_\phi = \pm .0233°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00083°$

$T_{MAN_\phi} = 19.491$ sec.

PITCH

$DR_\theta = \pm .0694°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .000253°$

$T_{MAN_\theta} = 17.563$ sec

YAW

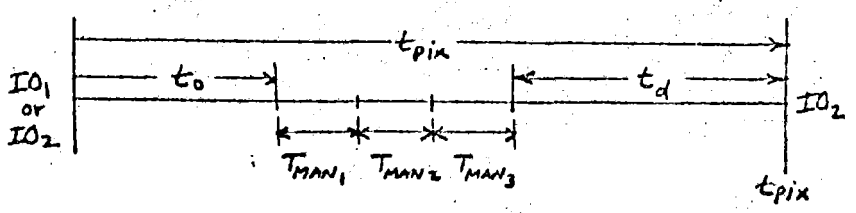
$DR_\psi = \pm$ $^{+.0125}_{-.0734}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .000233°$

$T_{MAN_\psi} = 21.576$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 87

MAN. ORDER RYP

MAN. ANGLES° 5.39

9.65

9.23

ROLL

$DR_\phi = \pm .0312°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00625°$

$T_{MAN_\phi} = 14.511$ sec.

PITCH

$DR_\theta = \pm .0405°$

$LS_{T/L_\theta} = \pm .0831°$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0000159°$

$T_{MAN_\theta} = 20.543$ sec

YAW

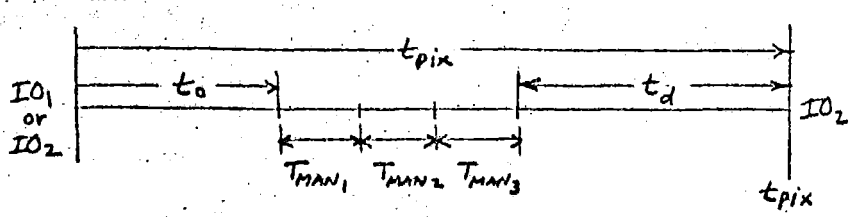
$DR_\psi = \pm$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0000146°$

$T_{MAN_\psi} = 21.636$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 93

MAN. ORDER R P Y

MAN. ANGLES° -59.19
5.91
-9.72

ROLL

$DR_\phi = \pm .0366°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00224°$

$T_{MAN_\phi} = 122.11$ sec.

PITCH

$DR_\theta = \pm .0381°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00282°$

$T_{MAN_\theta} = 13.90$ sec

YAW

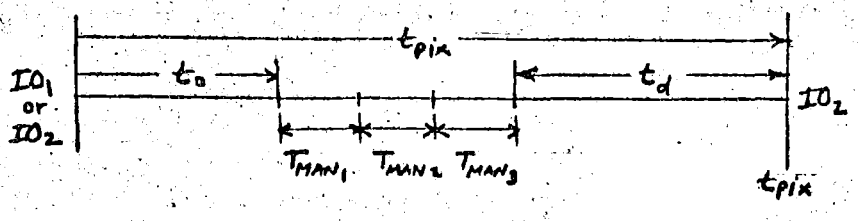
$DR_\psi = \pm .0409°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00269°$

$T_{MAN_\psi} = 21.78$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 99

MAN. ORDER R Y P

MAN. ANGLES° 5.47

9.79

0.

ROLL

$DR_\phi = \pm .0285°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00282°$

$T_{MAN_\phi} = 14.67$ sec.

PITCH

$DR_\theta = \pm .0346°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00403°$

$T_{MAN_\theta} = 0.$ sec

YAW

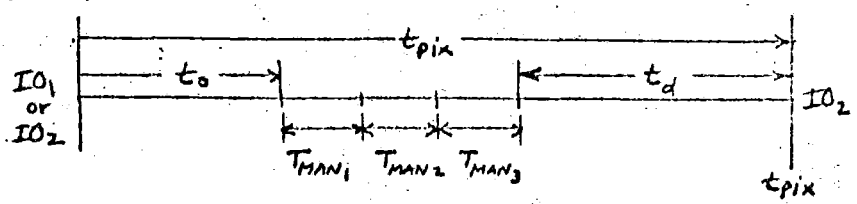
$DR_\psi = \pm$ °
$\pm .0177$

$LS_{T/L_\psi} = \pm .0537°$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00366°$

$T_{MAN_\psi} = 21.92$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 116

MAN. ORDER RYP

MAN. ANGLES 5.43

9.97

-7.20

ROLL

$DR_\phi = \pm \begin{matrix} +.0306 \\ -.0383 \end{matrix}$°

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm$ 0.°

$T_{MAN_\phi} = 14.591$ sec.

PITCH

$DR_\theta = \pm \begin{matrix} +.0566 \\ -.1853 \end{matrix}$°

$LS_{T/L_\theta} = \pm$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0.°

$T_{MAN_\theta} = 16.483$ sec

YAW

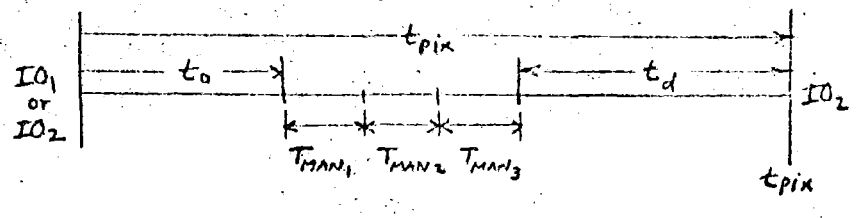
$DR_\psi = \pm \begin{matrix} +.0125 \\ -.0566 \end{matrix}$°

$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0.°

$T_{MAN_\psi} = 22.276$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 124

MAN. ORDER R,Y,P

MAN. ANGLES° 5.44
9.95
-8.69

ROLL

$\begin{cases} DR_\phi = \pm .0358^\circ \\ LS_{T/L_\phi} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm 0.^\circ$

$T_{MAN_\phi} = 14.611$ sec.

PITCH

$\begin{cases} DR_\theta = \pm \begin{matrix} +.0509 \\ -.1255 \end{matrix} \\ LS_{T/L_\theta} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.$

$T_{MAN_\theta} = 19.463$ sec.

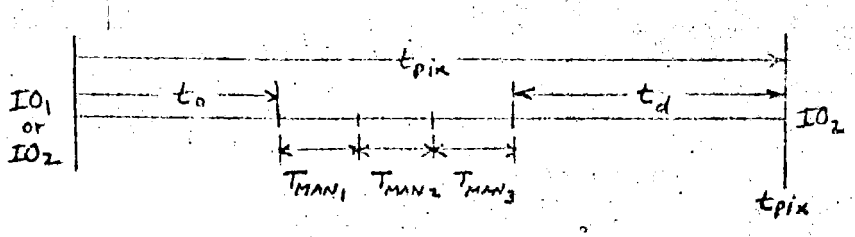
YAW

$\begin{cases} DR_\psi = \pm \begin{matrix} +.0134 \\ -.0506 \end{matrix} \\ LS_{T/L_\psi} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.$

$T_{MAN_\psi} = 22.236$ sec.

MANEUVER DATA SHEET



IO_1 ☒ IO_2 ☐

MISSION II

FRAME 132

MAN. ORDER R Y P

MAN. ANGLES 5.47
9.91
-10.17

ROLL

$\begin{cases} DR_\phi = \pm .0327^\circ \\ LS_{T/L_\phi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm 0.^\circ$

$T_{MAN_\phi} = 14:67$ sec.

PITCH

$\begin{cases} DR_\theta = \pm {}^{+.0437}_{-.1153}{}^\circ \\ LS_{T/L_\theta} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.^\circ$

$T_{MAN_\theta} = 22:42$ sec

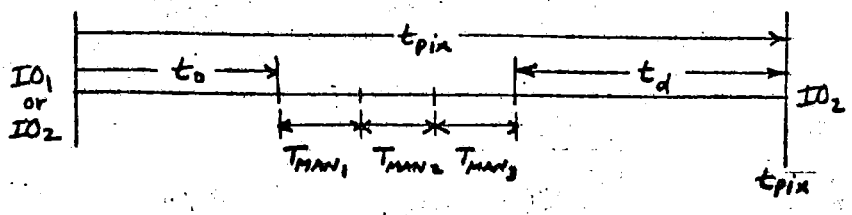
YAW

$\begin{cases} DR_\psi = \pm {}^{+.0126}_{-.0434}{}^\circ \\ LS_{T/L_\psi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.^\circ$

$T_{MAN_\psi} = 22:16$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION TF

FRAME 137

MAN. ORDER R Y P

MAN. ANGLES ° 5.50

9.95

71.49

ROLL

$DR_\phi = \pm .0410$ °

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm 0.$ °

$T_{MAN_\phi} = 14.731$ sec

PITCH

$DR_\theta = \pm$ $^{+.0243}_{-.0194}$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm 0.$ °

$T_{MAN_\theta} = 25.063$ sec

YAW

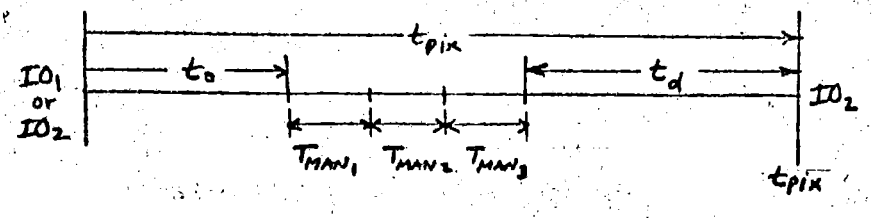
$DR_\psi = \pm$ $^{+.0125}_{-.0123}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm 0.$ °

$T_{MAN_\psi} = 22.236$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 141

MAN. ORDER R Y P

MAN. ANGLES ° 5.5

10.0

-4.2

ROLL

$\begin{cases} DR_\phi = \pm .0314^\circ \\ LS_{T/L_\phi} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0029^\circ$

$T_{MAN_\phi} = 14.73$ sec

PITCH

$\begin{cases} DR_\theta = \pm \begin{matrix} +.0127 \\ -.0706 \end{matrix}^\circ \\ LS_{T/L_\theta} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00395^\circ$

$T_{MAN_\theta} = 10.48$ sec

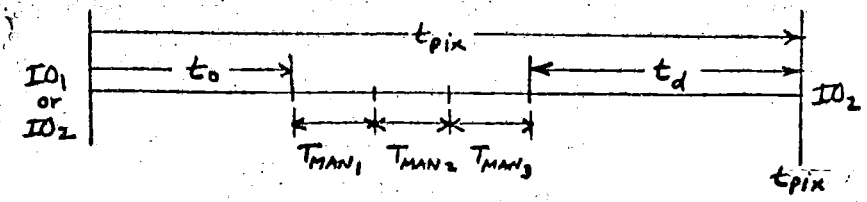
YAW

$\begin{cases} DR_\psi = \pm .0409^\circ \\ LS_{T/L_\psi} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00375^\circ$

$T_{MAN_\psi} = 22.34$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 162

MAN. ORDER RPY

MAN. ANGLES° 73.09

9.00

25.60

ROLL

$DR_\phi = \pm .0387°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .000607°$

$T_{MAN_\phi} = 14.91$ sec.

PITCH

$DR_\theta = \pm .0551°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .000187°$

$T_{MAN_\theta} = 20.08$ sec

YAW

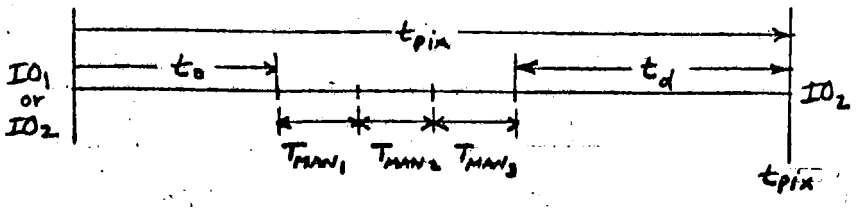
$DR_\psi = \pm$ $^{+.0372}_{-.0624}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .000154°$

$T_{MAN_\psi} = 53.54$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 166

MAN. ORDER R Y P

MAN. ANGLES° 5.55

10.0

-7.11

ROLL

$DR_\phi = \pm .0293°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm$ 0. °

$T_{MAN_\phi} = 14.83$ sec

PITCH

$DR_\theta = \pm$ $^{+.0370}_{-.0610}$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 16.91$ sec

YAW

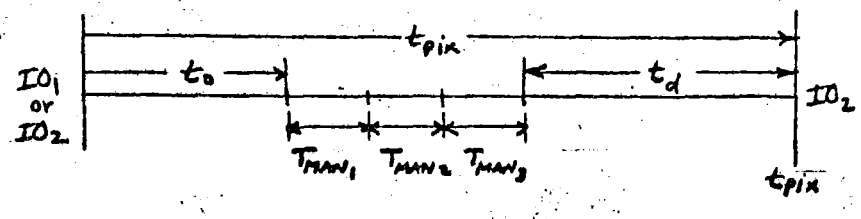
$DR_\psi = \pm$ $^{+.0125}_{-.0127}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 22.39$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION 71

FRAME 174

MAN. ORDER R Y P

MAN. ANGLES° 5.57

10.02

-8.92

ROLL

$DR_\phi = \pm .0332°$

$LS_{T/L_\phi} = \pm$ •

$RIM(t_{pix} - T_{MAN_\phi}) = \pm$ 0. •

$T_{MAN_\phi} = 14.27$ sec

PITCH

$DR_\theta = \pm$ $^{+.0130}_{-.1213}$ •

$LS_{T/L_\theta} = \pm$ •

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. •

$T_{MAN_\theta} = 19.92$ sec

YAW

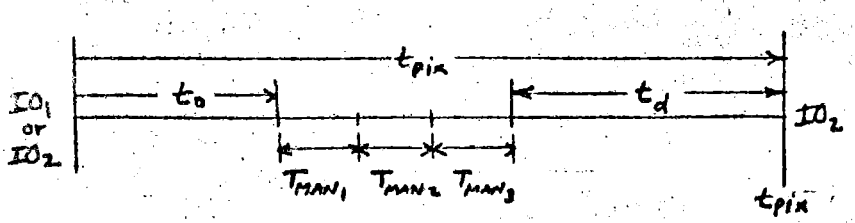
$DR_\psi = \pm$ $^{+.0133}_{-.0451}$ •

$LS_{T/L_\psi} = \pm$ •

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. •

$T_{MAN_\psi} = 22.38$ sec.

MANEUVER DATA SHEET



IO_1 ☒ IO_2 ☐

MISSION II

FRAME 196

MAN. ORDER R Y P

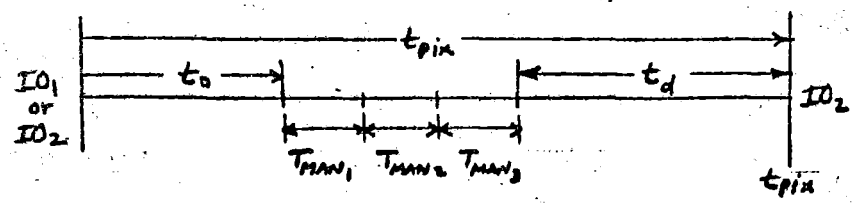
MAN. ANGLES° -17.80

0.

0.

ROLL	PITCH	YAW
$DR_\phi = \pm .0221°$	$DR_\theta = \pm .0125°$ / $\pm .0378°$	$DR_\psi = \pm .0395°$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pix} - T_{MAN_\phi}) = \pm .000753°$	$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °	$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °
$T_{MAN_\phi} = 359.731$ sec.	$T_{MAN_\theta} =$ 0. sec.	$T_{MAN_\psi} =$ 0. sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II-

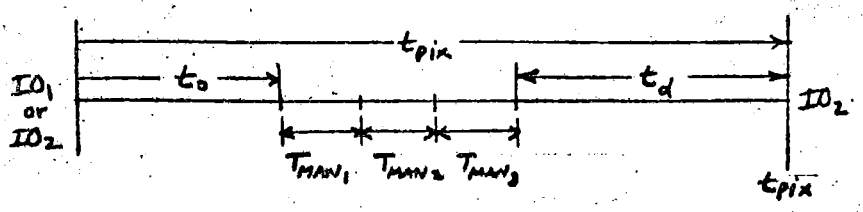
FRAME 200

MAN. ORDER RYP

MAN. ANGLES° 5.62
10.16
1.62

ROLL	PITCH	YAW
$DR_\phi = \pm .0290°$	$DR_\theta = \pm$ $^{+.0718}_{-.0728}°$	$DR_\psi = \pm$ $^{+.0125}_{-.1033}°$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pin}-T_{MAN_\phi}) = \pm .00239°$	$RIM(t_{pin}-T_{MAN_\theta}) = \pm .00343°$	$RIM(t_{pin}-T_{MAN_\psi}) = \pm .00314°$
$T_{MAN_\phi} = 17.377$ sec.	$T_{MAN_\theta} = 5.323$ sec	$T_{MAN_\psi} = 22.656$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION FT

FRAME 208

MAN. ORDER RYP

MAN. ANGLES° 5.6

10.2

0.12

ROLL

$DR_\phi = \pm .0311°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00436°$

$T_{MAN_\phi} = 14.93$ sec.

PITCH

$DR_\theta = \pm$ °

$\pm .0125$

$\pm .1207$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00349°$

$T_{MAN_\theta} = 7.41$ sec

YAW

$DR_\psi = \pm$ °

$\pm .0128$

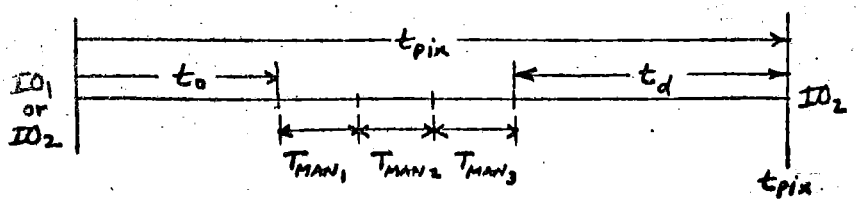
$\pm .0417$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00313°$

$T_{MAN_\psi} = 22.74$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 214

MAN. ORDER R Y P

MAN. ANGLES ° 5.52

10.30

7.67

ROLL

$DR_\phi = \pm .0261°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .0216°$

$T_{MAN_\phi} = 14.77$ sec.

PITCH

$DR_\theta = \pm$ $^{+.0155}_{-.0411}$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm .0324°$

$T_{MAN_\theta} = 17.42$ sec

YAW

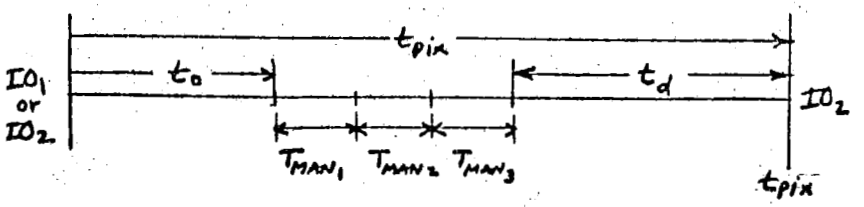
$DR_\psi = \pm$ $^{+.0125}_{-.0226}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm .0315°$

$T_{MAN_\psi} = 22.94$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME 215

MAN. ORDER RPY

MAN. ANGLES ° 63.4
25.0
15.2

ROLL

$DR_\phi = \pm .0324$ °

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0455$ °

$T_{MAN_\phi} = 130.531$ sec

PITCH

$DR_\theta = \pm .0437$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0$ °

$T_{MAN_\theta} = 52.083$ sec

YAW

$DR_\psi = \pm$ °
$+.0454$
$-.1374$

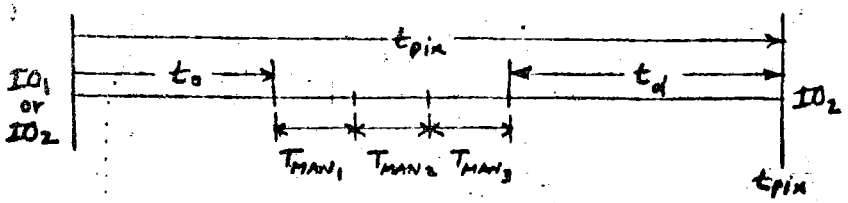
$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0$ °

$T_{MAN_\psi} = 32.736$ sec.

215

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 12

MAN. ORDER R V P

MAN. ANGLES° −17.84
17.86
3.98

ROLL

$DR_\phi = \pm .0242°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .000284°$

$T_{MAN_\phi} = 37.526$ sec

PITCH

$DR_\theta = \pm$ $\pm .0499$ $\pm .1134$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm .000721°$

$T_{MAN_\theta} = 10.213$ sec

YAW

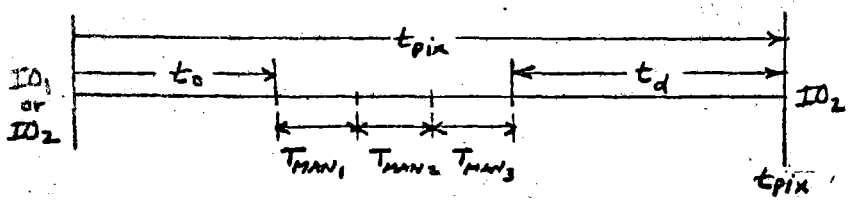
$DR_\psi = \pm$ $\pm .0987$ $\pm .0125$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm .000470°$

$T_{MAN_\psi} = 38.195$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 22

MAN. ORDER RYP

MAN. ANGLES −17.84
17.86
3.98

ROLL

$DR_\phi = \pm .0292°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00256°$

$T_{MAN_\phi} = 39.58$ sec.

PITCH

$DR_\theta = \pm$ $^{+.0199}_{-.1134}$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .000712°$

$T_{MAN_\theta} = 10.21$ sec

YAW

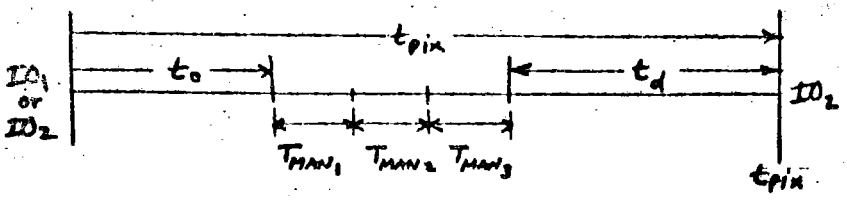
$DR_\psi = \pm$ $^{+.0987}_{-.0125}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .000464°$

$T_{MAN_\psi} = 38.19$ sec.

MANEUVER DATA SHEET



ID_1 ☑ ID_2 ☐

MISSION III

FRAME 28

MAN. ORDER RYP

MAN. ANGLES -20.98
16.51
-5.38

ROLL

$DR_\phi = \pm .0271°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .00324°$

$T_{MAN_\phi} = 45.80$ sec.

PITCH

$DR_\theta = \pm .0415°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm .0007°$

$T_{MAN_\theta} = 13.03$ sec.

YAW

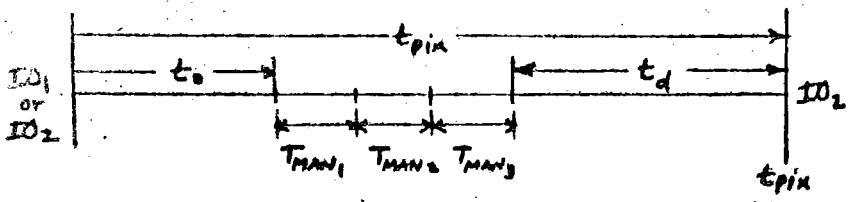
$DR_\psi = \pm$ ° $\pm .0384$

$LS_{T/L_\psi} = \pm .0184°$

$RIM(t_{pin} - T_{MAN_\psi}) = \pm .0005°$

$T_{MAN_\psi} = 35.50$ sec.

MANEUVER DATA SHEET



IO1 ☑ IO2 ☐

MISSION III

FRAME 34

MAN. ORDER R Y P

MAN. ANGLES° 2.12
25.39
1.36

ROLL

$DR_\phi = \pm .0407°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .0114°$

$T_{MAN_\phi} = 8.09$ sec.

PITCH

$DR_\theta = \pm .0600°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 4.99$ sec.

YAW

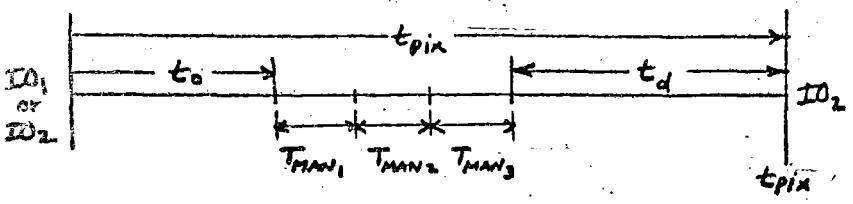
$DR_\psi = \pm .0568°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 53.26$ sec.

MANEUVER DATA SHEET



ID_1 ☑ ID_2 ☐

MISSION III

FRAME 37

MAN. ORDER RYP

MAN. ANGLES 90.00
0
-55.00

ROLL

$DR_\phi = \pm .2048°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00822°$

$T_{MAN_\phi} = 192.85$ sec.

PITCH

$DR_\theta = \pm .2137°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00048°$

$T_{MAN_\theta} = 172.27$ sec

YAW

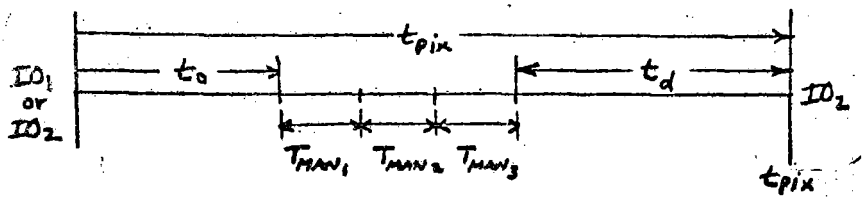
$DR_\psi = \pm .2133°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00053°$

$T_{MAN_\psi} = 20$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 38

MAN. ORDER R Y P

MAN. ANGLES -67.44

-10.34

-10.60

ROLL

$DR_\phi = \pm .0271°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0032°$

$T_{MAN_\phi} = 132.73$ sec.

PITCH

$DR_\theta = \pm$ $^{+.0399}_{-.0364}$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00066°$

$T_{MAN_\theta} = 23.48$ sec

YAW

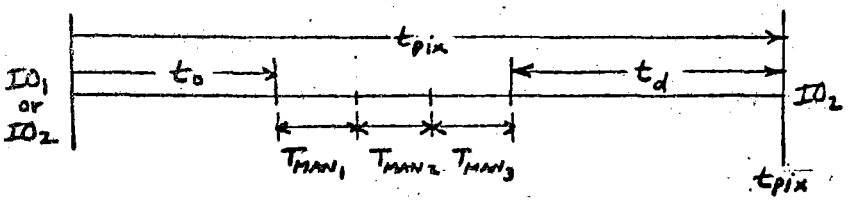
$DR_\psi = \pm .0361°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0005°$

$T_{MAN_\psi} = 23.16$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 39

MAN. ORDER RPY

MAN. ANGLES -77.15

-55.00

0

ROLL

$DR_\phi = \pm .0424°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00180°$

$T_{MAN_\phi} = 158.15$ sec.

PITCH

$DR_\theta = \pm .0645°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0 °

$T_{MAN_\theta} = 142.27$ sec

YAW

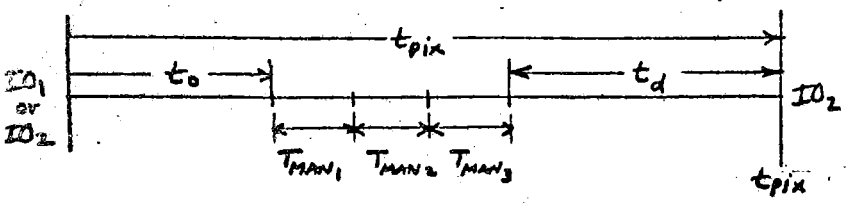
$DR_\psi = \pm .0617°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0 °

$T_{MAN_\psi} = 86.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 41

MAN. ORDER RYP

MAN. ANGLES -34.58
13.52
3.12

ROLL

$DR_\phi = \pm .0274°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0008°$

$T_{MAN_\phi} = 72.99$ sec.

PITCH

$DR_\theta = \pm$ $^{+.0466}_{-.2730}$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 8.52$ sec

YAW

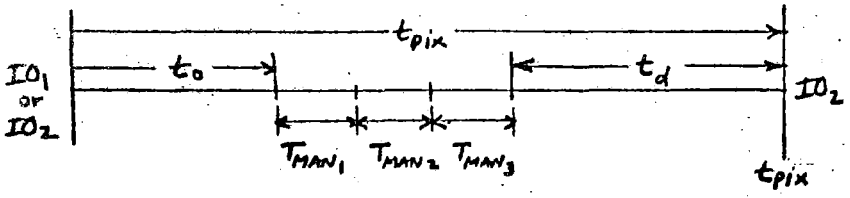
$DR_\psi = \pm$ $^{\pm .0423}_{-.0190}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 29.54$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 47

MAN. ORDER RYP

MAN. ANGLES −13.69

19.48

1.06

ROLL

$DR_\phi = \pm .0383°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00027°$

$T_{MAN_\phi} = 31.21$ sec.

PITCH

$DR_\theta = \pm$ $^{+.0411}_{-.0435}$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 4.40$ sec

YAW

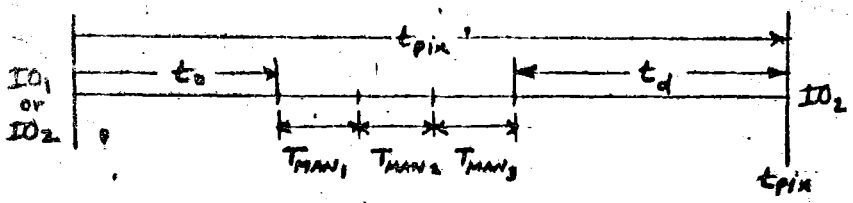
$DR_\psi = \pm$ $^{+.0381}_{-.0154}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 41.42$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 55

MAN. ORDER RYP

MAN. ANGLES° ' −30.98

13.11

−2.94

ROLL

$\begin{cases} DR_\phi = \pm .0259^\circ \\ LS_{T/L_\phi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm 0.^\circ$

$T_{MAN_\phi} = 65.80$ sec

PITCH

$\begin{cases} DR_\theta = \pm \begin{matrix} +.0742 \\ -.1048 \end{matrix} ^\circ \\ LS_{T/L_\theta} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.^\circ$

$T_{MAN_\theta} = 8.15$ sec

YAW

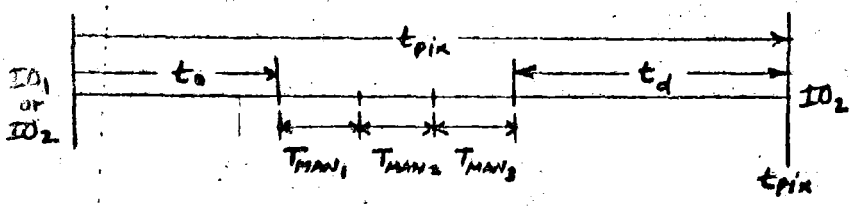
$\begin{cases} DR_\psi = \pm \begin{matrix} +.0738 \\ -.0170 \end{matrix} ^\circ \\ LS_{T/L_\psi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.^\circ$

$T_{MAN_\psi} = 28.70$ sec.

D2 100814 3

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 63

MAN. ORDER R Y P

MAN. ANGLES° -.35

2.179

.17

ROLL

$DR_\phi = \pm .0392°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .000927$ °

$T_{MAN_\phi} = 16.516$ sec.

PITCH

$DR_\theta = \pm .0634°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm$ 0.. °

$T_{MAN_\theta} = 8.593$ sec

YAW

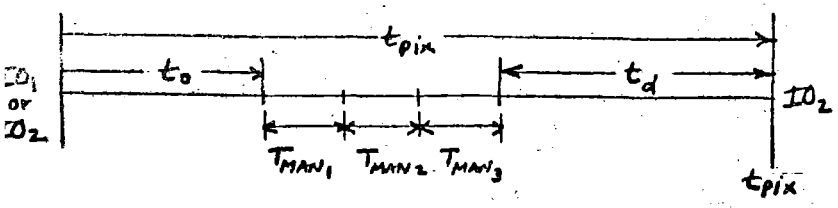
$DR_\psi = \pm .0125°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 46.055$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 69

MAN. ORDER R/P

MAN. ANGLES -24.70

15.80

-1.63

ROLL

$DR_\phi = \pm .0272°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm 0.$ °

$T_{MAN_\phi} = 52.25$ sec.

PITCH

$DR_\theta = \pm .0555°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.$ °

$T_{MAN_\theta} = 5.53$ sec

YAW

$DR_\psi = \pm$ $^{+.0514}_{-.0176}$ °

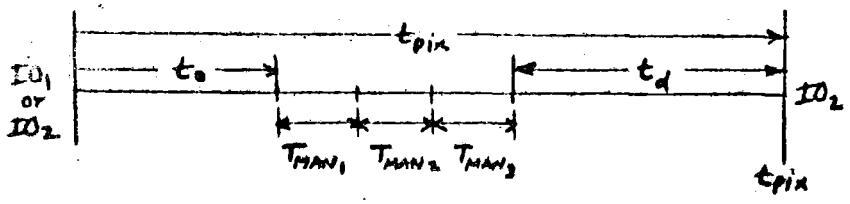
$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.$ °

$T_{MAN_\psi} = 34.07$ sec.

D2 100814 3

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 72

MAN. ORDER RPY

MAN. ANGLES° 3.29
4.35
25.72

ROLL

$DR_\phi = \pm .0358°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00336°$

$T_{MAN_\phi} = 10.72$ sec.

PITCH

$DR_\theta = \pm .0392°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00075°$

$T_{MAN_\theta} = 10.96$ sec

YAW

$DR_\psi = \pm .0410°$

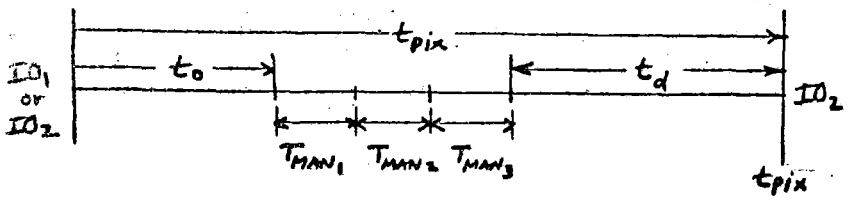
$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00046°$

$T_{MAN_\psi} = 53.93$ sec.

MANEUVER DATA SHEET

D2 100814 3



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 73

MAN. ORDER RPY

MAN. ANGLES 26.83
29.69
21.49

ROLL

$DR_\phi = \pm .0267°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00070°$

$T_{MAN_\phi} = 57.50$ sec.

PITCH

$DR_\theta = \pm .0610°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.$ °

$T_{MAN_\theta} = 61.65$ sec

YAW

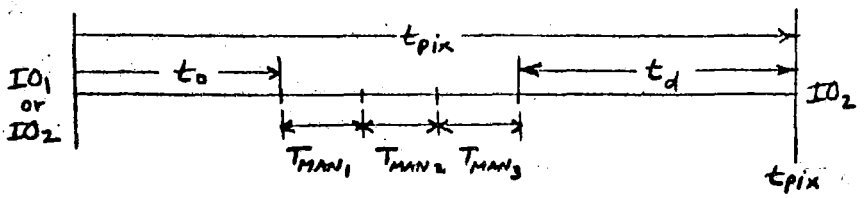
$DR_\psi = \pm$ $^{+.0607}_{-.0977}$ °

$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.$ °

$T_{MAN_\psi} = 45.44$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 75

MAN. ORDER RYP

MAN. ANGLES -12.448
18.379
10.552

ROLL

$DR_\phi = \pm .0266°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00234°$

$T_{MAN_\phi} = 36.74$ sec

PITCH

$DR_\theta = \pm$ °

$LS_{T/L_\theta} = \pm {}^{+.0717}_{-.2159}°$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00067°$

$T_{MAN_\theta} = 23.37$ sec

YAW

$DR_\psi = \pm .0127°$

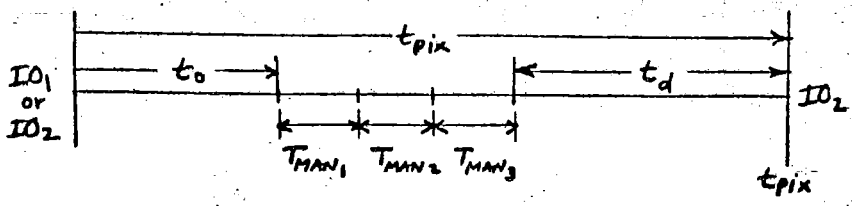
$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00048°$

$T_{MAN_\psi} = 39.22$ sec.

75.

MANEUVER DATA SHEET



IO1 ☑ IO2 ☐

MISSION III

FRAME 78

MAN. ORDER RPY

MAN. ANGLES −21.54
7.60
−17.39

ROLL

$DR_\phi = \pm .0324°$

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00023°$

$T_{MAN_\phi} = 196.92$ sec.

PITCH

$DR_\theta = \pm .0652°$

$LS_{T/L_\theta} = \pm$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.°$

$T_{MAN_\theta} = 17.47$ sec

YAW

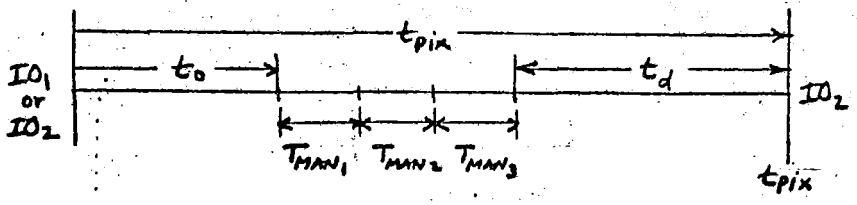
$DR_\psi = \pm .0732°$

$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.°$

$T_{MAN_\psi} = 37.26$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 81

MAN. ORDER R Y P

MAN. ANGLES -12.68

20.21

-2.06

ROLL

$DR_\phi = \pm .0278°$

$LS_{T/L_\phi} = \pm$ •

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0075°$

$T_{MAN_\phi} = 29.19$ sec.

PITCH

$DR_\theta = \pm$ $^{+.0559}_{-.1405}$ •

$LS_{T/L_\theta} = \pm$ •

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. •

$T_{MAN_\theta} = 6.39$ sec

YAW

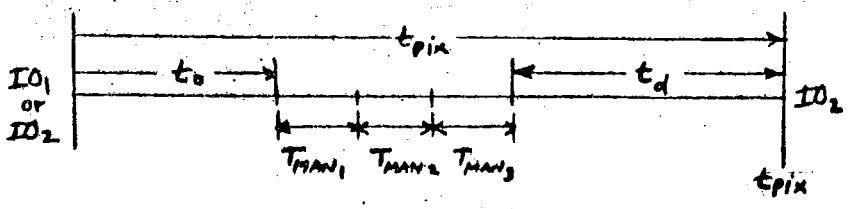
$DR_\psi = \pm$ $^{+.0555}_{-.0185}$ •

$LS_{T/L_\psi} = \pm$ •

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. •

$T_{MAN_\psi} = 42.89$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 89

MAN. ORDER RYP

MAN. ANGLES° −40.08

11.16

−1.03

ROLL

$DR_\phi = \pm .0225°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .00020°$

$T_{MAN_\phi} = 83.99$ sec.

PITCH

$DR_\theta = \pm .0714°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 4.31$ sec

YAW

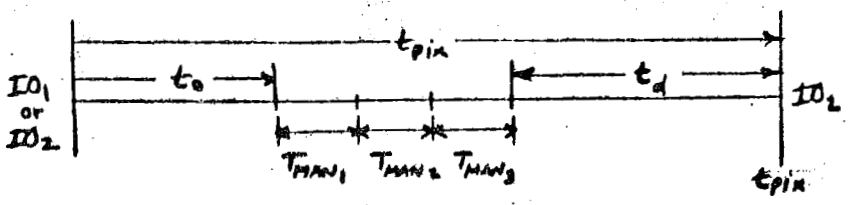
$DR_\psi = \pm$ $^{+.0147}_{-.0125}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 24.81$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 97

MAN. ORDER RYP

MAN. ANGLES -27.08
15.49
0.77

ROLL

$DR_\phi = \pm .0242°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .00028°$

$T_{MAN_\phi} = 57.986$ sec.

PITCH

$DR_\theta = \pm .0626$ / $-.0734$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm 0.$ °

$T_{MAN_\theta} = 3.717$ sec

YAW

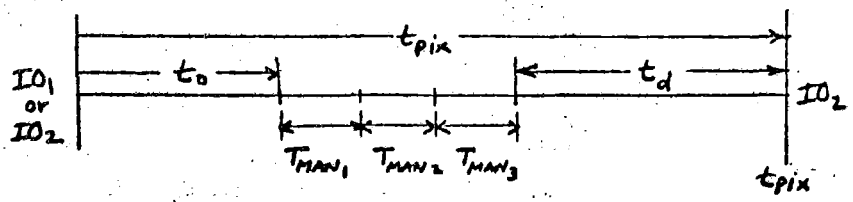
$DR_\psi = \pm .0622°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm 0.$ °

$T_{MAN_\psi} = 33.455$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 102

MAN. ORDER R P Y

MAN. ANGLES 20.003
10.495
22.349

ROLL

$DR_\phi = \pm .0270°$

$LS_{T/L_\phi} = \pm$ •

$RIM(t_{pix} - T_{MAN_\phi}) = \pm$ 0. °

$T_{MAN_\phi} = 43.84$ sec.

PITCH

$DR_\theta = \pm .0349°$

$LS_{T/L_\theta} = \pm$ •

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. •

$T_{MAN_\theta} = 23.28$ sec

YAW

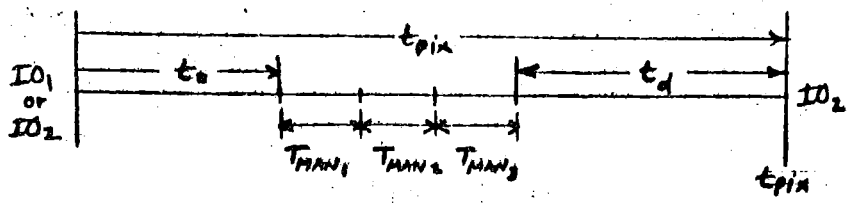
$DR_\psi = \pm$ •
$\pm .0345$
$-.0452$

$LS_{T/L_\psi} = \pm$ •

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. •

$T_{MAN_\psi} = 47.18$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 120

MAN. ORDER RPY

MAN. ANGLES° −69.07

−55.00

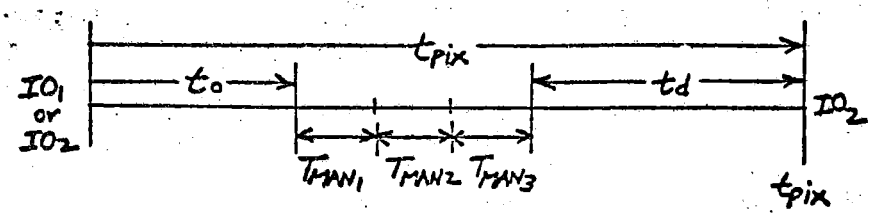
0

ROLL	PITCH	YAW
$DR_\phi = \pm .0272°$	$DR_\theta = \pm .0487°$	$DR_\psi = \pm .0487°$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pin}-T_{MAN_\phi}) = \pm .00289°$	$RIM(t_{pin}-T_{MAN_\theta}) = \pm .00060°$	$RIM(t_{pin}-T_{MAN_\psi}) = \pm .00073°$
$T_{MAN_\phi} = 141.96$ sec	$T_{MAN_\theta} = 142.27$ sec	$T_{MAN_\psi} =$ 01 sec.

120

MANEUVER DATA SHEET

D2 100814 3



IO1 ☑ IO2 ☐

MISSION III

FRAME 121

MAN. ORDER RYP

MAN. ANGLES 169.40

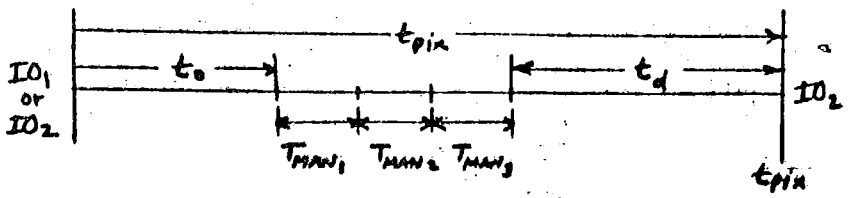
0.

0.

ROLL	PITCH	YAW
$DR_\phi = \pm .0245°$	$DR_\theta = \pm .0596°$	$DR_\psi = \pm$ .0579 / .0254 °
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00812°$	$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00812°$	$RIM(t_{pix} - T_{MAN\psi}) = \pm$ 0. °
$T_{MAN_\phi} = 342.64$ sec	$T_{MAN_\theta} =$ 0. sec	$T_{MAN\psi} =$ 0. sec.

121

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

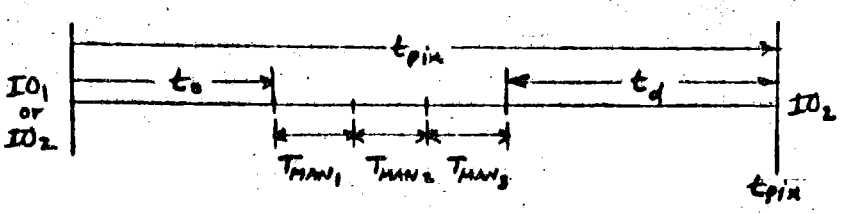
FRAME 136

MAN. ORDER RPY

MAN. ANGLES° -78.42 / -52.76 / 0

ROLL	PITCH	YAW
$DR_\phi = \pm .0384°$	$DR_\theta = \pm .0610°$	$DR_\psi = \pm .0593°$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pin}-T_{MAN_\phi}) = \pm .0008°$	$RIM(t_{pin}-T_{MAN_\theta}) = \pm 0.$ °	$RIM(t_{pin}-T_{MAN_\psi}) = \pm 0.$ °
$T_{MAN_\phi} = 160.70$ sec	$T_{MAN_\theta} = 107.81$ sec	$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 140

MAN. ORDER R/P

MAN. ANGLES° -51.58

2.95

-7.82

ROLL

$DR_\phi = \pm .0399°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm$ 0. °

$T_{MAN_\phi} = 107.00$ sec.

PITCH

$DR_\theta = \pm .0539°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 17.91$ sec

YAW

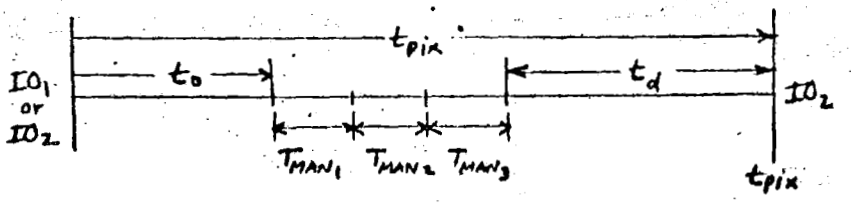
$DR_\psi = \pm$ °

$LS_{T/L_\psi} = \pm {}^{+.0508}_{-.0129}$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 8.37$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 148

MAN. ORDER RYP

MAN. ANGLES° -24.71
15.57
-4.75

ROLL

$DR_\phi = \pm .0310°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm$ 0. °

$T_{MAN_\phi} = 53.28$ sec.

PITCH

$DR_\theta = \pm$ $^{+.0640}_{-.0750}$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 11.78$ sec

YAW

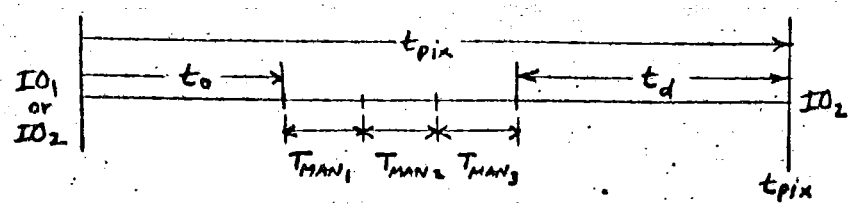
$DR_\psi = \pm$ $^{+.0637}_{-.0180}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 33.61$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 156

MAN. ORDER RYP

MAN. ANGLES° -14.42
19.74
-3.02

ROLL

$\begin{cases} DR_\phi = \pm .0292^\circ \\ LS_{T/L_\phi} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm 0.$

$T_{MAN_\phi} = 32.69$ sec.

PITCH

$\begin{cases} DR_\theta = \pm {}^{+.0663}_{-.2399}{}^\circ \\ LS_{T/L_\theta} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.$

$T_{MAN_\theta} = 8.32$ sec

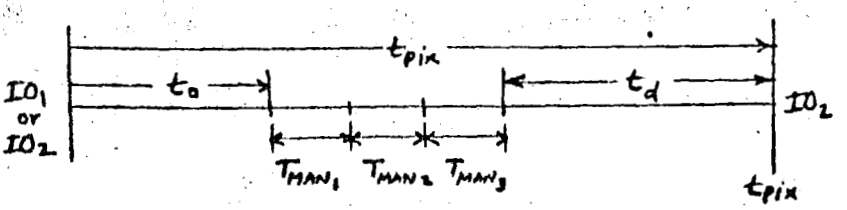
YAW

$\begin{cases} DR_\psi = \pm {}^{+.0669}_{-.0143}{}^\circ \\ LS_{T/L_\psi} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.$

$T_{MAN_\psi} = 41.94$ sec.

MANEUVER DATA SHEET



IO1 ☑ IO2 ☐

MISSION III

FRAME 161

MAN. ORDER RPY

MAN. ANGLES -20.73
-54.46
0

ROLL

$DR_\phi = \pm .0377°$

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00278°$

$T_{MAN_\phi} = 45.306$ sec.

PITCH

$DR_\theta = \pm$ $\pm .0252$ $\pm .0686°$

$LS_{T/L_\theta} = \pm$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00056°$

$T_{MAN_\theta} = 111.193$ sec

YAW

$DR_\psi = \pm$ $\pm .0667$ $\pm .0343°$

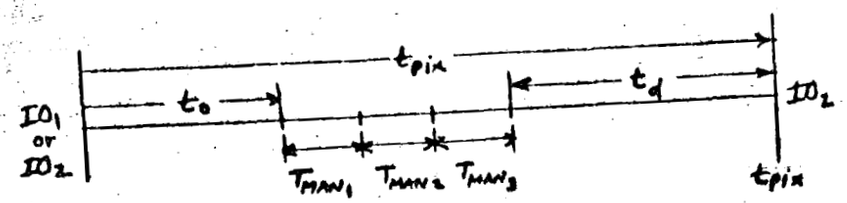
$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00070°$

$T_{MAN_\psi} = 0.$ sec.

D2 100814 3

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 166

MAN. ORDER RYP

MAN. ANGLES° 1.92
22.15
14.01

ROLL

$DR_\phi = \pm .0256°$

$LS_{T/L_\phi} = \pm$ •

$RIM(t_{pin} - T_{MAN_\phi}) = \pm$ 0. •

$T_{MAN_\phi} = 7.6$[illegible] sec

PITCH

$DR_\theta = \pm$ [illegible] •

$LS_{T/L_\theta} = \pm$ [illegible] •

$RIM(t_{pin} - T_{MAN_\theta}) = \pm$ 0. •

$T_{MAN_\theta} = 30.293$ sec

YAW

$DR_\psi = \pm .0596°$

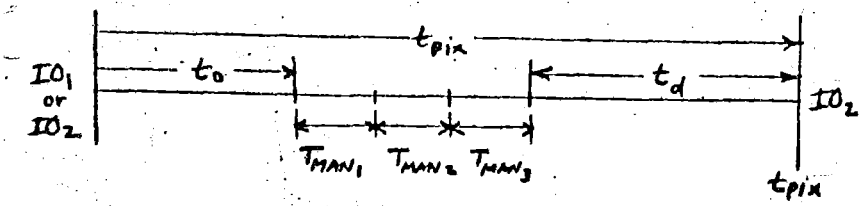
$LS_{T/L_\psi} = \pm$ •

$RIM(t_{pin} - T_{MAN_\psi}) = \pm$ 0. •

$T_{MAN_\psi} = 46.775$ sec.

165.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 171

MAN. ORDER R P Y

MAN. ANGLES° −71.48

−55.00

0

ROLL

$DR_\phi = \pm .0411°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .008°$

$T_{MAN_\phi} = 146.81$ sec.

PITCH

$DR_\theta = \pm .0460°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.$ °

$T_{MAN_\theta} = 112.27$ sec

YAW

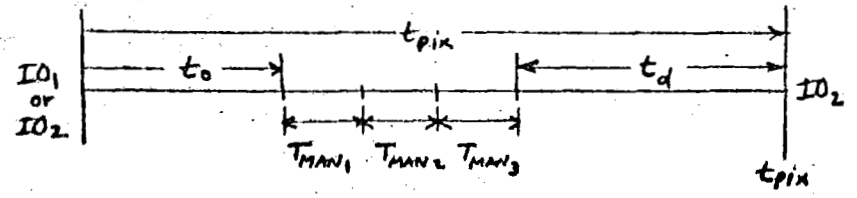
$DR_\psi = \pm .0439°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.$ °

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 172

MAN. ORDER RPY

MAN. ANGLES -73.54

-53.46

0

ROLL

$DR_\phi = \pm .0279°$

$LS_{T/L_\phi} = \pm$ •

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00020°$

$T_{MAN_\phi} = 150.92$ sec.

PITCH

$DR_\theta = \pm .0644°$

$LS_{T/L_\theta} = \pm$ •

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. •

$T_{MAN_\theta} = 109.19$ sec

YAW

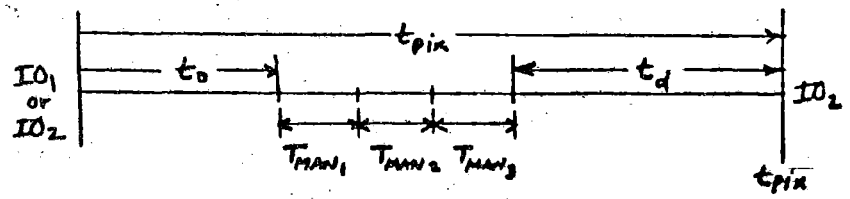
$DR_\psi = \pm .0618°$

$LS_{T/L_\psi} = \pm$ •

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. •

$T_{MAN_\psi} =$ 0. sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

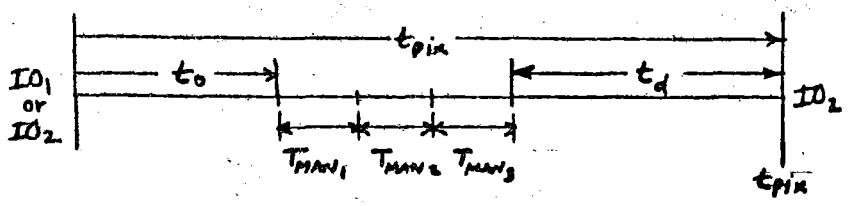
FRAME 176

MAN. ORDER R Y P

MAN. ANGLES° -19.26
17.80
-3.35

ROLL	PITCH	YAW
$DR_\phi = \pm .0429°$	$DR_\theta = \pm$ $^{+.0479}_{-.2192}°$	$DR_\psi = \pm$ $^{+.0306}_{-.0125}°$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pix}-T_{MAN_\phi}) = \pm .00306°$	$RIM(t_{pix}-T_{MAN_\theta}) = \pm .00071°$	$RIM(t_{pix}-T_{MAN_\psi}) = \pm .00046°$
$T_{MAN_\phi} = 42.57$ sec.	$T_{MAN_\theta} = 8.97$ sec	$T_{MAN_\psi} = 38.07$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 182.

MAN. ORDER R/P

MAN. ANGLES -34.20

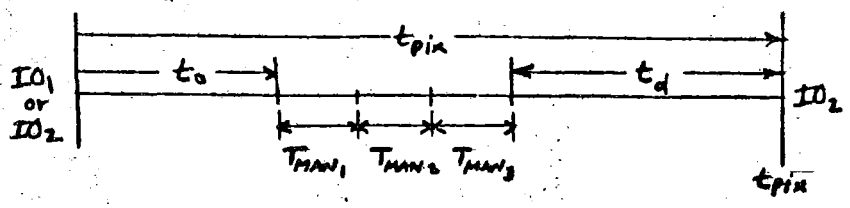
12.43

-3.07

ROLL	PITCH	YAW
$DR_\phi = \pm .0289°$	$DR_\theta = \pm$ 4.0478	$DR_\psi = \pm$ 4.0475
$LS_{T/L_\phi} = \pm$	$LS_{T/L_\theta} = \pm$ .1678	$LS_{T/L_\psi} = \pm$ .0136
$RIM(t_{pin} - T_{MAN_\phi}) = \pm$ 0.	$RIM(t_{pin} - T_{MAN_\theta}) = \pm$ 0.	$RIM(t_{pin} - T_{MAN_\psi}) = \pm$ 0.
$T_{MAN_\phi} =$ 20.35 sec.	$T_{MAN_\theta} =$ 18.91 sec.	$T_{MAN_\psi} =$ 24.34 sec.

182

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 192

MAN. ORDER PYP

MAN. ANGLES -28.09
14.68
-2.69

ROLL

$DR_\phi = \pm .0370°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .00088°$

$T_{MAN_\phi} = 66.21$ sec.

PITCH

$DR_\theta = \pm$ $\pm .0478$ $\pm .1210$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm$ °

$T_{MAN_\theta} = 7.65$ sec

YAW

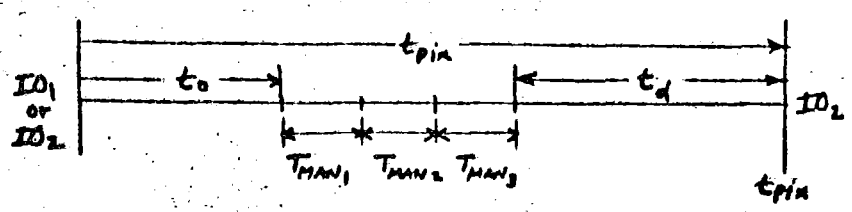
$DR_\psi = \pm .0474°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm$ °

$T_{MAN_\psi} = 21.84$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 202

MAN. ORDER R Y P

MAN. ANGLES -20.36
17.60
-2.49

ROLL

$DR_\phi = \pm .0279°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .00227°$

$T_{MAN_\phi} = 4.760$ sec

PITCH

$DR_\theta = \pm .0467°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 7.25$ sec

YAW

$DR_\psi = \pm$ $^{+.0905}_{-.0162}$ °

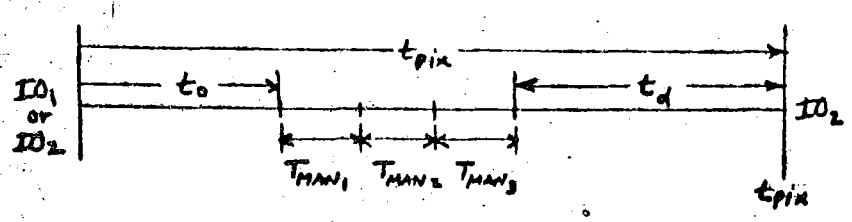
$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 37.67$ sec.

D2 100814 3

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 208

MAN. ORDER R Y P

MAN. ANGLES° 15.47
26.94
11.26

ROLL

$DR_\phi = \pm .0254°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00301°$

$T_{MAN_\phi} = 34:39$ sec.

PITCH

$DR_\theta = \pm$ $^{+.0564}_{-.0622}$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0068°$

$T_{MAN_\theta} = 24:39$ sec

YAW

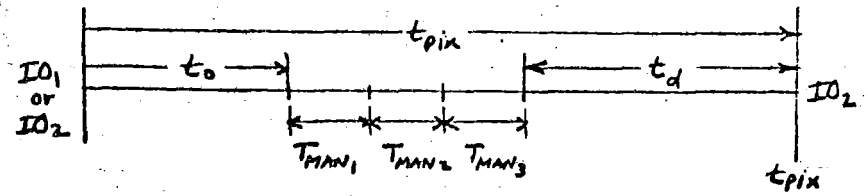
$DR_\psi = \pm .0598°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0005°$

$T_{MAN_\psi} = 56:36$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 213

MAN. ORDER RYP

MAN. ANGLES -90.01

-2.49

-1.23

ROLL

$DR_\phi = \pm {}^{+.0498}_{-.0328}$°

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm 0.$ °

$T_{MAN_\phi} = 16.87$ sec.

PITCH

$DR_\theta = \pm {}^{+.0851}_{-.0715}$°

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.$ °

$T_{MAN_\theta} = 4.71$ sec

YAW

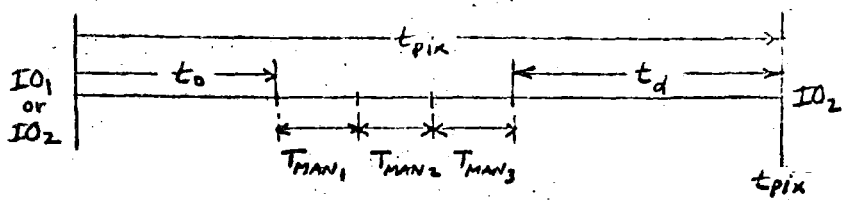
$DR_\psi = \pm .0711$°

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.$ °

$T_{MAN_\psi} = 7.15$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION III

FRAME 215

MAN. ORDER RYP

MAN. ANGLES -15.65
18.96
12.73

ROLL

$DR_\phi = \pm .0288°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00065°$

$T_{MAN_\phi} = 35.15$ sec.

PITCH

$DR_\theta = \pm .0710°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 27.68$ sec

YAW

$DR_\psi = \pm$ $\pm .0697$ / $\pm .0206$ °

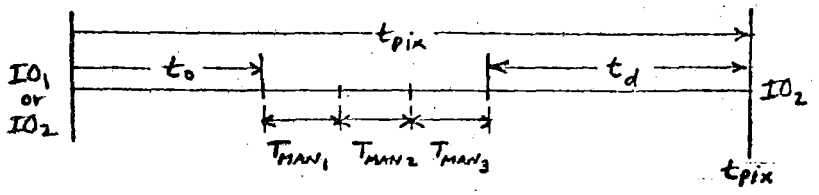
$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 40.40$ sec.

215

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME 6

MAN. ORDER R P Y

MAN. ANGLES ° 48.38
15.82
27.39

ROLL

$DR_\phi = \pm .0394°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0045°$

$T_{MAN_\phi} = 100.54$ sec

PITCH

$DR_\theta = \pm .0353°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0007°$

$T_{MAN_\theta} = 34.02$ sec

YAW

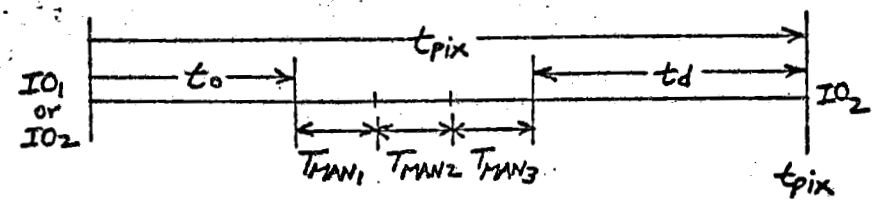
$DR_\psi = \pm$ $^{+.0350}_{-.2136}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0284°$

$T_{MAN_\psi} = 57.44$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 10 A

MAN. ORDER (12)PY

MAN. ANGLES 0

30.61

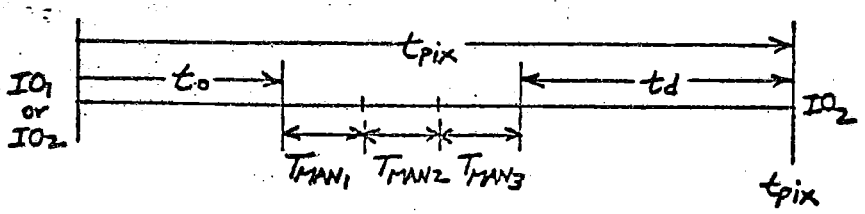
-36.83

ROLL	PITCH	YAW
$DR_\phi = \pm .0177°$	$DR_\theta = \pm .0229°$	$DR_\psi = \pm .0230°$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L\psi} = \pm$ °
$RIM(t_{pix} - T_{MAN\phi}) = \pm .00061°$	$RIM(t_{pix} - T_{MAN\theta}) = \pm .00079°$	$RIM(t_{pix} - T_{MAN\psi}) = \pm .00079°$
$T_{MAN\phi} =$ 0. sec	$T_{MAN\theta} =$ 63.58 sec	$T_{MAN\psi} =$ 76.32 sec.

10A

MANEUVER DATA SHEET

D2 100814 3



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 10R

MAN. ORDER (R) P(Y)

MAN. ANGLES 0

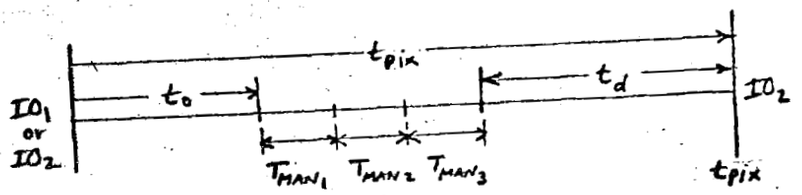
-35.72

0

ROLL	PITCH	YAW
$DR_\phi = \pm$ $\pm .0148$ $\pm .0285$ °	$DR_\theta = \pm .0335$ °	$DR_\psi = \pm .0167$ °
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00710$ °	$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00565$ °	$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0240$ °
$T_{MAN_\phi} = 0.$ sec	$T_{MAN_\theta} = 73.81$ sec	$T_{MAN_\psi} = 0.$ sec.

10B

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 14

MAN. ORDER R P Y

MAN. ANGLES° -23.17

-12.44

0.

ROLL

$DR_\phi = \pm .0240°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00363°$

$T_{MAN_\phi} = 60.11$ sec

PITCH

$DR_\theta = \pm .0161°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0052°$

$T_{MAN_\theta} = 27.24$ sec

YAW

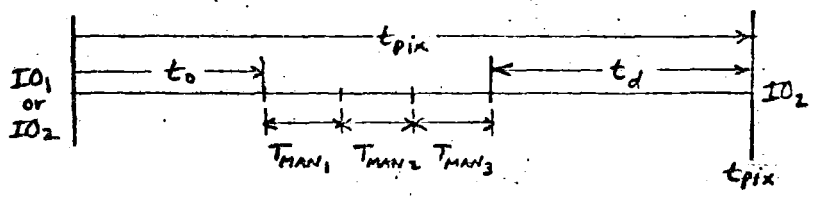
$DR_\psi = \pm .0193°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0220°$

$T_{MAN_\psi} = 0.$ sec

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 18

MAN. ORDER RPY

MAN. ANGLES° -30.44
-3.47
0.

ROLL

$DR_\phi = \pm .0189°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0035°$

$T_{MAN_\phi} = 64.66$ sec.

PITCH

$DR_\theta = \pm .0168°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0057°$

$T_{MAN_\theta} = 9.29$ sec

YAW

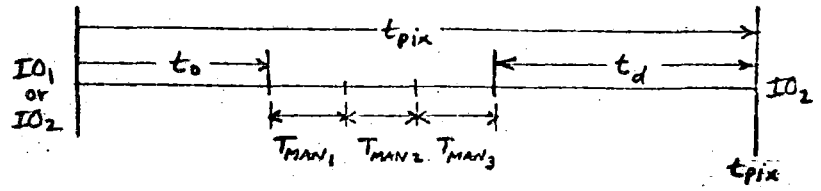
$DR_\psi = \pm .0184°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0213°$

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 22

MAN. ORDER RPY

MAN. ANGLES° -30.06

5.22

0.

ROLL

$DR_\phi = \pm .0210°$

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00380°$

$T_{MAN_\phi} = 63.91$ sec.

PITCH

$DR_\theta = \pm .0169°$

$LS_{T/L_\theta} = \pm 0°$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00556°$

$T_{MAN_\theta} = 13.80$ sec

YAW

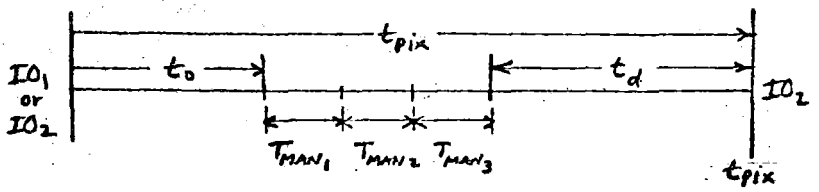
$DR_\psi = \pm .0169°$

$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0230°$

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME 25

MAN. ORDER R P Y

MAN. ANGLES° 167.0 P
45.0
0.

ROLL

$\begin{cases} DR_\phi = \pm .0279^\circ \\ LS_{T/L_\phi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0050^\circ$

$T_{MAN_\phi} = 337.95$ sec

PITCH

$\begin{cases} DR_\theta = \pm \begin{matrix} +.0624 \\ -.0221 \end{matrix}^\circ \\ LS_{T/L_\theta} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0416^\circ$

$T_{MAN_\theta} = 92.36$ sec

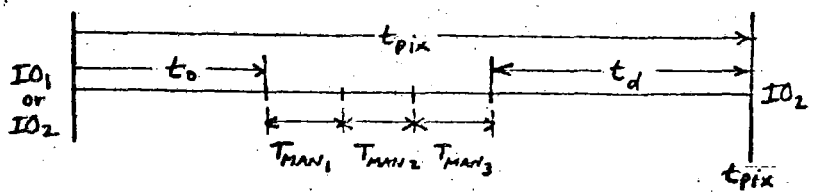
YAW

$\begin{cases} DR_\psi = \pm .0593^\circ \\ LS_{T/L_\psi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0289^\circ$

$T_{MAN_\psi} = 0.$ sec

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II-C

FRAME (26)

MAN. ORDER RYP

MAN. ANGLES° 29.83
-0.52
6.87

ROLL

$DR_\phi = \pm .0292°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00349°$

$T_{MAN_\phi} = 63.43$ sec

PITCH

$DR_\theta = \pm$ $^{+.0717}_{-.0569}$°

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00112°$

$T_{MAN_\theta} = 16.09$ sec

YAW

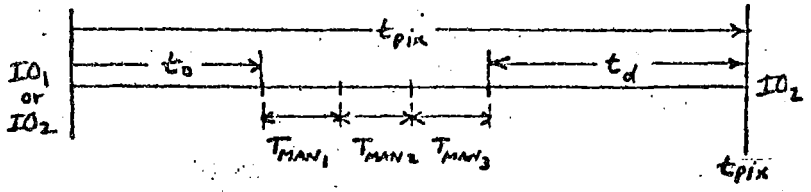
$DR_\psi = \pm .0649°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00433°$

$T_{MAN_\psi} = 3.35$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

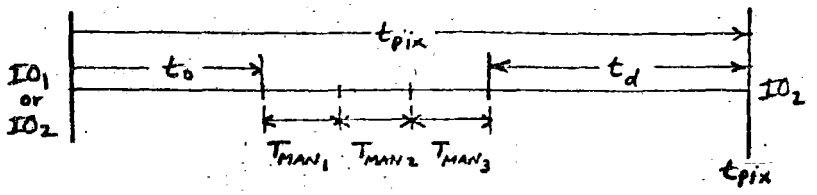
FRAME (27)

MAN. ORDER R P Y

MAN. ANGLES° -23.17
-12.50
0.

ROLL	PITCH	YAW
$DR_\phi = \pm .0211°$	$DR_\theta = \pm .0183°$	$DR_\psi = \pm$ $+.1352$ $-.0125$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pix}-T_{MAN_\phi}) = \pm .00055°$	$RIM(t_{pix}-T_{MAN_\theta}) = \pm .00089°$	$RIM(t_{pix}-T_{MAN_\psi}) = \pm .00364°$
$T_{MAN_\phi} = 60.11$ sec	$T_{MAN_\theta} = 27.35$ sec	$T_{MAN_\psi} = 0.$ sec

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION II

FRAME (28)

MAN. ORDER R P Y

MAN. ANGLES° −30.42.

−3.60

0.

ROLL

$\begin{cases} DR_\phi = \pm .025^\circ \\ LS_{T/L_\phi} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0008^\circ$

$T_{MAN_\phi} = 69.64$ sec

PITCH

$\begin{cases} DR_\theta = \pm \overset{+.2041}{-.0125}^\circ \\ LS_{T/L_\theta} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0013^\circ$

$T_{MAN_\theta} = 9.55$ sec

YAW

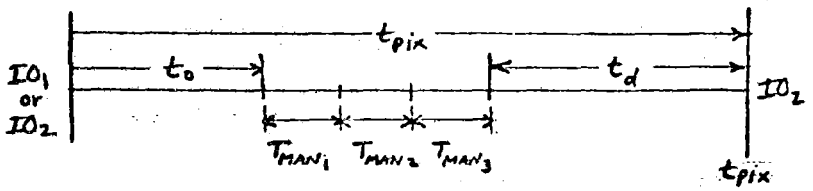
$\begin{cases} DR_\psi = \pm \overset{+.0712}{-.0125}^\circ \\ LS_{T/L_\psi} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0033^\circ$

$T_{MAN_\psi} = 0.$ sec

D2 100814 3

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IVC

FRAME (29)

MAN. ORDER R P Y

MAN. ANGLES° −30.03

5.66

0.

ROLL

$DR_\phi = \pm .0185°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0037°$

T_{MAN_ϕ} = 42.65 sec

PITCH

$DR_\theta = \pm .0191°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00356°$

T_{MAN_θ} = 13.69 sec

YAW

$DR_\psi = \pm$ 1.1933°

$LS_{T/L_\psi} = \pm$ .0125°

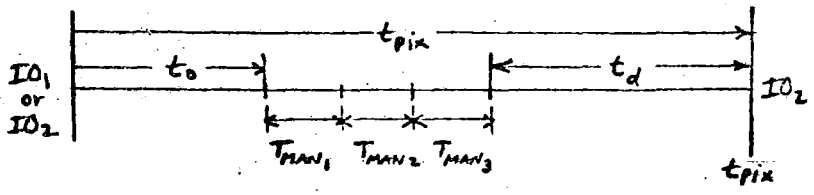
$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0229°$

T_{MAN_ψ} = 0. sec

SD 2-7837-0-1 3-68

29

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 30

MAN. ORDER RPY

MAN. ANGLES° -22.01
3.92
-23.69

ROLL

$DR_\phi = \pm .0267°$

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0011°$

$T_{MAN_\phi} = 42.81$ sec

PITCH

$DR_\theta = \pm .0326°$

$LS_{T/L_\theta} = \pm$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0001°$

$T_{MAN_\theta} = 10.21$ sec

YAW

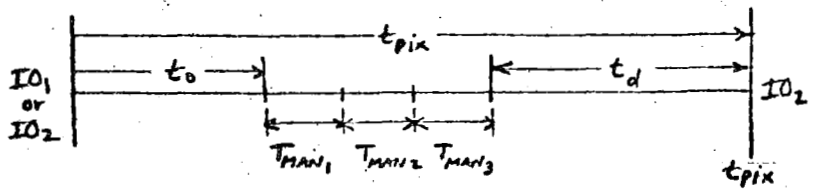
$DR_\psi = \pm$ ~~.0157~~ .0256°

$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0059°$

$T_{MAN_\psi} = 50.03$ sec

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION II

FRAME (38)

MAN. ORDER RYP

MAN. ANGLES° 29.98
-1.21
7.60

ROLL

$DR_\phi = \pm .0427°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0032°$

$T_{MAN_\phi} = 62.19$ sec

PITCH

$DR_\theta = \pm .0637°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 17.56$ sec

YAW

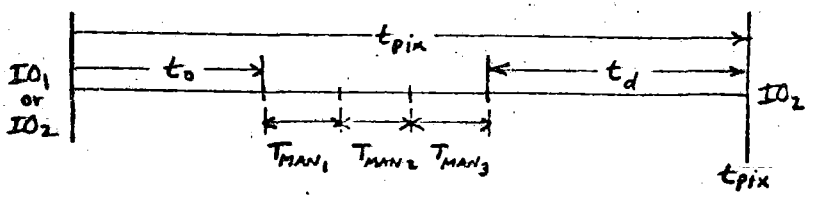
$DR_\psi = \pm .0607°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0003°$

$T_{MAN_\psi} = 5.07$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME (39)

MAN. ORDER RPY

MAN. ANGLES -29.18

-12.53

0.

ROLL

$DR_\phi = \pm .0314°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00028°$

$T_{MAN_\phi} = 60.15$ sec

PITCH

$DR_\theta = \pm .0125°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00014°$

$T_{MAN_\theta} = 27.42$ sec

YAW

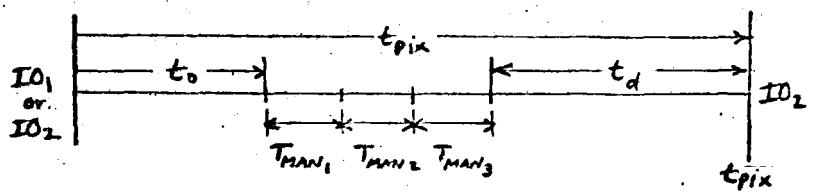
$DR_\psi = \pm$ $^{+.0283}_{-.0127}$°

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00017°$

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME (10)

MAN. ORDER R P Y

MAN. ANGLES° −30.42

−3.59

0.

ROLL

$DR_\phi = \pm .0210°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0004°$

$T_{MAN_\phi} = 64.63$ sec

PITCH

$DR_\theta = \pm .0152°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0069°$

$T_{MAN_\theta} = 2.54$ sec

YAW

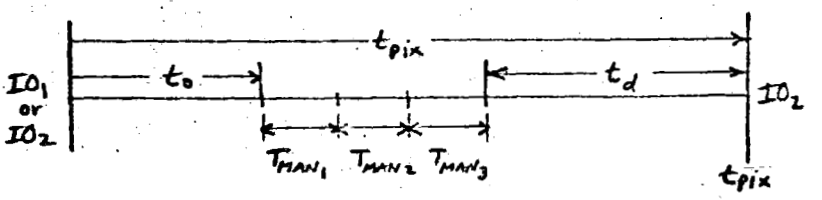
$DR_\psi = \pm .0204°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0028°$

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME (41)

MAN. ORDER R P Y

MAN. ANGLES° -30.02

5.67

0.

ROLL

$DR_\phi = \pm .025°$

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0025°$

$T_{MAN_\phi} = 13.13$ sec

PITCH

$DR_\theta = \pm$ ~~.0125~~ .1673

$LS_{T/L_\theta} = \pm$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00309°$

$T_{MAN_\theta} = 13.70$ sec

YAW

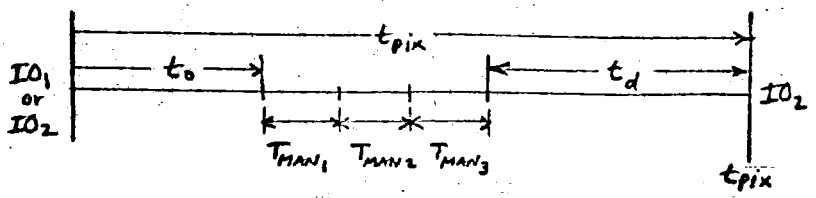
$DR_\psi = \pm .02°$

$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0129°$

$T_{MAN_\psi} = 0.$ sec

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 42

MAN. ORDER RPY

MAN. ANGLES° -22.01

3.93

-23.70

ROLL

$DR_\phi = \pm$ .0872°

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm$ 0°

$T_{MAN_\phi} =$ 47.84 sec

PITCH

$DR_\theta = \pm$ .0206°

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ .00012°

$T_{MAN_\theta} =$ 10.22 sec

YAW

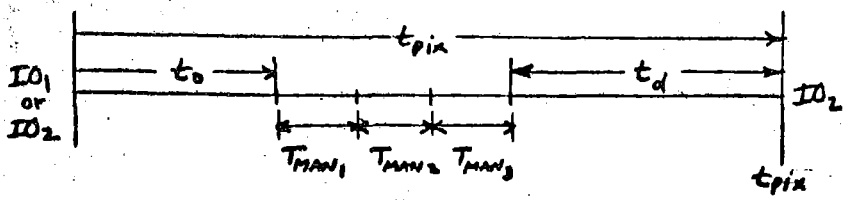
$DR_\psi = \pm$ .0872°

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ .00087°

$T_{MAN_\psi} =$ 32.06 sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME (64)

MAN. ORDER RVP

MAN. ANGLES° 30.43
-2.76
8.92

ROLL

$DR_\phi = \pm .0405°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .0300°$

$T_{MAN_\phi} = 65.36$ sec.

PITCH

$DR_\theta = \pm .0318°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm .00161°$

$T_{MAN_\theta} = 20.20$ sec

YAW

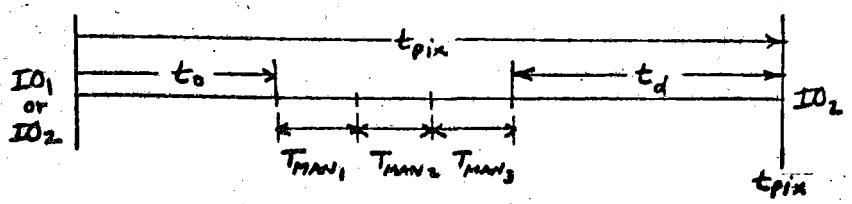
$DR_\psi = \pm .0603°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm .00676°$

$T_{MAN_\psi} = 8.18$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 65

MAN. ORDER R P Y

MAN. ANGLES° -28.24

-12.55

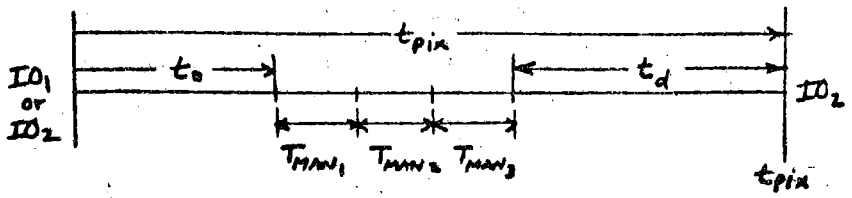
0.

ROLL	PITCH	YAW
$DR_\phi = \pm .0246°$	$DR_\theta = \pm .0154°$	$DR_\psi = \pm .0202°$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pin} - T_{MAN_\phi}) = \pm .00188°$	$RIM(t_{pin} - T_{MAN_\theta}) = \pm .00277°$	$RIM(t_{pin} - T_{MAN_\psi}) = \pm .0117°$
$T_{MAN_\phi} = 60.26$ sec.	$T_{MAN_\theta} = 27.46$ sec.	$T_{MAN_\psi} = 0.$ sec.

65

D2 100814 3

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 66

MAN. ORDER RPY

MAN. ANGLES ° -30.42

-3.58

0.

ROLL

$DR_\phi = \pm .0377°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .00174°$

$T_{MAN_\phi} = 64.64$ sec.

PITCH

$DR_\theta = \pm .0191°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm .00265°$

$T_{MAN_\theta} = 9.51$ sec

YAW

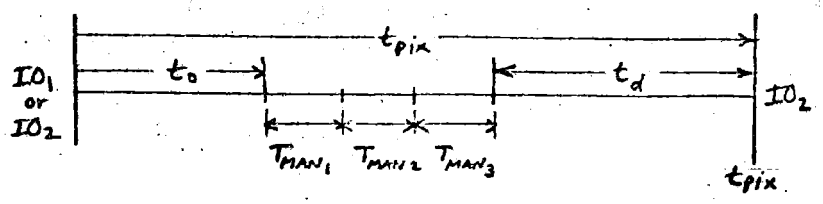
$DR_\psi = \pm .0385°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm .0110°$

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME (70A)

MAN. ORDER RYP

MAN. ANGLES° 0.

30.16

-9.35

ROLL

$DR_\phi = \pm .0254°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0264°$

$T_{MAN_\phi} =$ 0. sec

PITCH

$DR_\theta = \pm$ °

$LS_{T/L_\theta} = \pm {}^{+.0712}_{-.2376}$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .000454°$

$T_{MAN_\theta} =$ 21.06 sec

YAW

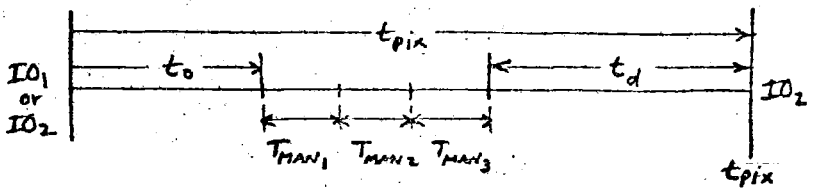
$DR_\psi = \pm .0706°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0013°$

$T_{MAN_\psi} =$ 62.98 sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☐

MISSION IX

FRAME (70B)

MAN. ORDER PYP

MAN. ANGLES* 58.84

0.

0.

ROLL

$\begin{cases} DR_\phi = \pm \ ^{+.0274}_{-.0125}{}^\circ \\ LS_{T/L_\phi} = \pm \ ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00103^\circ$

$T_{MAN_\phi} = 105.52$ sec

PITCH

$\begin{cases} DR_\theta = \pm .0142^\circ \\ LS_{T/L_\theta} = \pm \ ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00176^\circ$

$T_{MAN_\theta} = 0.$ sec

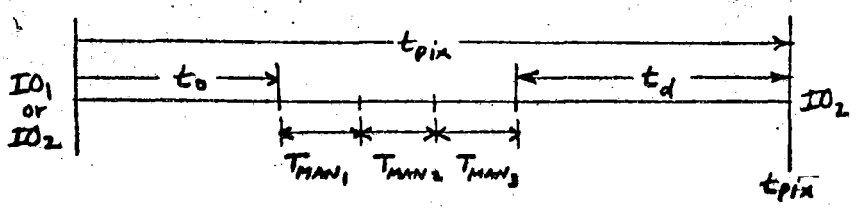
YAW

$\begin{cases} DR_\psi = \pm .0974^\circ \\ LS_{T/L_\psi} = \pm \ ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00725^\circ$

$T_{MAN_\psi} =$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME (71)

MAN. ORDER R P Y

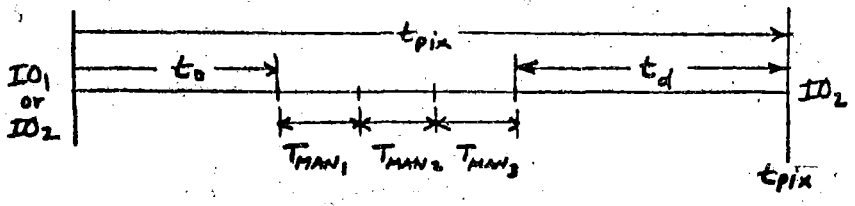
MAN. ANGLES° −19.49

1.20

−33.72

ROLL	PITCH	YAW
$DR_\phi = \pm .0395°$	$DR_\theta = \pm .0196°$	$DR_\psi = \pm$ $^{+.0125}_{-.0764}°$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pin}-T_{MAN_\phi}) = \pm .00460°$	$RIM(t_{pin}-T_{MAN_\theta}) = \pm .00667°$	$RIM(t_{pin}-T_{MAN_\psi}) = \pm .0266°$
$T_{MAN_\phi} = 42.77$ sec.	$T_{MAN_\theta} = 4.76$ sec.	$T_{MAN_\psi} = 79.11$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME (72)

MAN. ORDER R P Y

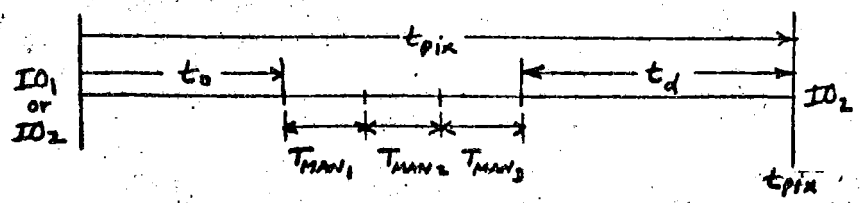
MAN. ANGLES ° -28.76

-12.55

0.

ROLL	PITCH	YAW
$DR_\phi = \pm .0309$ °	$DR_\theta = \pm .0213$ °	$DR_\psi = \pm$ $^{+.0141}_{-.0125}$ °
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pix}-T_{MAN_\phi}) = \pm .00362$ °	$RIM(t_{pix}-T_{MAN_\theta}) = \pm .00527$ °	$RIM(t_{pix}-T_{MAN_\psi}) = \pm .02169$ °
$T_{MAN_\phi} = 60.31$ sec.	$T_{MAN_\theta} = 27.46$ sec.	$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

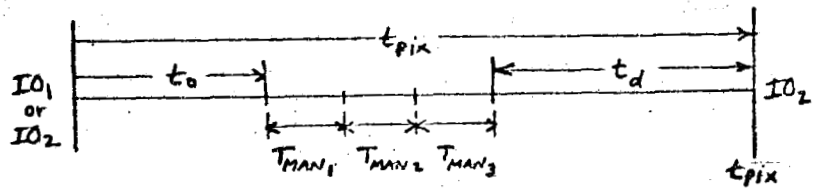
FRAME 73

MAN. ORDER R P Y

MAN. ANGLES -30.42
-3.57
0.

ROLL	PITCH	YAW
$DR_\phi = \pm .0188°$	$DR_\theta = \pm .0169°$	$DR_\psi = \pm .0183°$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00399°$	$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00514°$	$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0212°$
$T_{MAN_\phi} = 69.69$ sec.	$T_{MAN_\theta} = 9.99$ sec.	$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME 75

MAN. ORDER RPY

MAN. ANGLES° −192.29

45.00

0.

ROLL

$DR_\phi = \pm .0319°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm {}^{.1615°}_{.0348}$

$T_{MAN_\phi} = 38837$ sec

PITCH

$DR_\theta = \pm .0726°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00012°$

$T_{MAN_\theta} = 92.36$ sec

YAW

$DR_\psi = \pm .0711°$

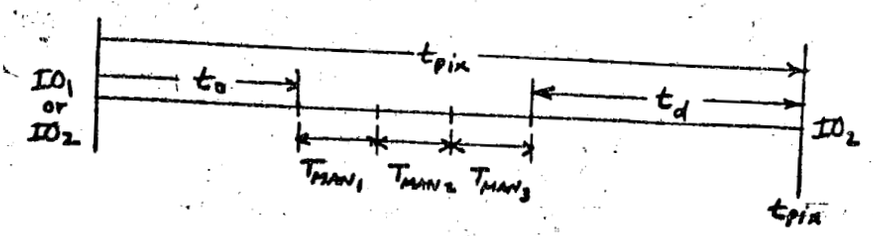
$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0015°$

$T_{MAN_\psi} = 0.$ sec

MANEUVER DATA SHEET

D2 100814 3



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME (82)

MAN. ORDER R P Y

MAN. ANGLES° 4.92

17.84

25.45

ROLL

$DR_\phi = \pm .0421°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .0278°$

$T_{MAN_\phi} = 105.62$ sec.

PITCH

$DR_\theta = \pm .0481°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm .0449°$

$T_{MAN_\theta} = 38.04$ sec.

YAW

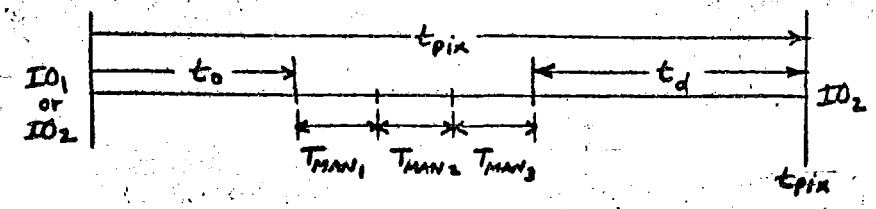
$DR_\psi = \pm .0494°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm .0595°$

$T_{MAN_\psi} = 53.57$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 1831

MAN. ORDER R P Y

MAN. ANGLES ° -19.49

1.21

-33.72

ROLL

$DR_\phi = \pm .0183°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00303°$

$T_{MAN_\phi} = 42.57$ sec.

PITCH

$DR_\theta = \pm .0286°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00497°$

$T_{MAN_\theta} = 4.78$ sec

YAW

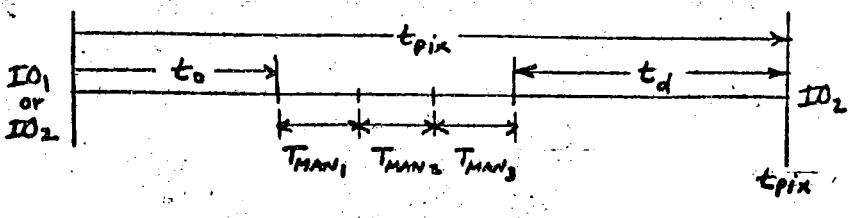
$DR_\psi = \pm .0126°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0173°$

$T_{MAN_\psi} = 70.11$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 84

MAN. ORDER R P Y

MAN. ANGLES° -29.30

-12.56

0.

ROLL

$DR_\phi = \pm .0198°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0015°$

$T_{MAN_\phi} = 60.39$ sec.

PITCH

$DR_\theta = \pm .0175°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0027°$

$T_{MAN_\theta} = 27.45$ sec

YAW

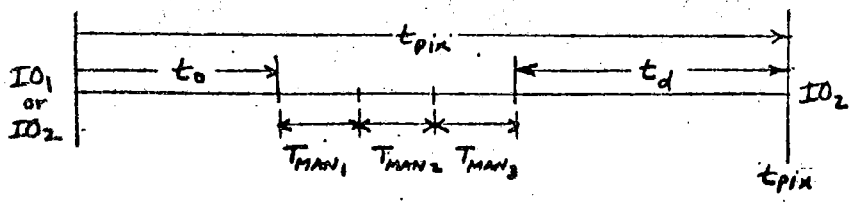
$DR_\psi = \pm$ $^{+.0363}_{-.0288}$°

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .011°$

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 85

MAN. ORDER RPY

MAN. ANGLES ° -30.43
-3.57
0.

ROLL

$DR_\phi = \pm .0219°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .0034°$

$T_{MAN_\phi} = 64.64$ sec.

PITCH

$DR_\theta = \pm .0142°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm .0052°$

$T_{MAN_\theta} = 9.49$ sec

YAW

$DR_\psi = \pm .0220°$

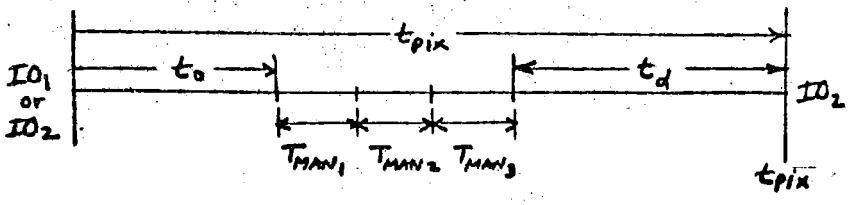
$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm .0211°$

$T_{MAN_\psi} = 0.$ sec.

85

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

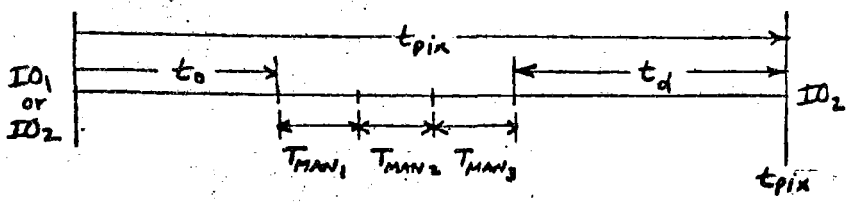
FRAME (100)

MAN. ORDER R Y P

MAN. ANGLES° 31.09
-5.11
10.80

ROLL	PITCH	YAW
$DR_\phi = \pm .0364°$	$DR_\theta = \pm$ $\pm .0539$ $.0504$	$DR_\psi = \pm .0501°$
$LS_{T/L_\phi} = \pm$	$LS_{T/L_\theta} = \pm$	$LS_{T/L_\psi} = \pm$
$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0125°$	$RIM(t_{pix} - T_{MAN_\theta}) = \pm$	$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0013°$
$T_{MAN_\phi} = 65.23$ sec.	$T_{MAN_\theta} = 23.96$ sec	$T_{MAN_\psi} = 12.88$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 101

MAN. ORDER R P Y

MAN. ANGLES ° −25.74

−12.56

0.

ROLL

$DR_\phi = \pm .0182°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0063°$

$T_{MAN_\phi} = 60.47$ sec.

PITCH

$DR_\theta = \pm .0193°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0052°$

$T_{MAN_\theta} = 27.42$ sec

YAW

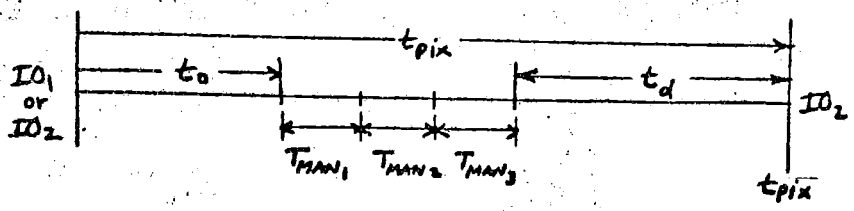
$DR_\psi = \pm$ ° $\pm .0273$ $\pm .0288$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0219°$

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 102

MAN. ORDER R P Y

MAN. ANGLES ° -30.43

-3.57

0.

ROLL

$DR_\phi = \pm .0290°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0005°$

$T_{MAN_\phi} = 64.65$ sec

PITCH

$DR_\theta = \pm .0127°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00132°$

$T_{MAN_\theta} = 9.48$ sec

YAW

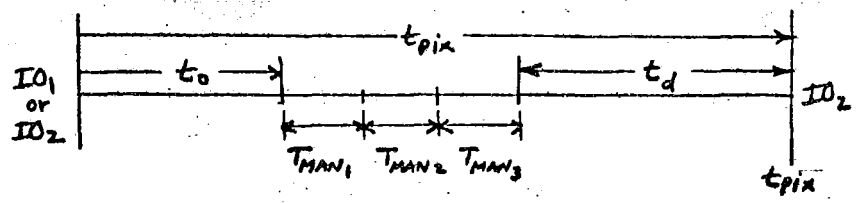
$DR_\psi = \pm .0296°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00550°$

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

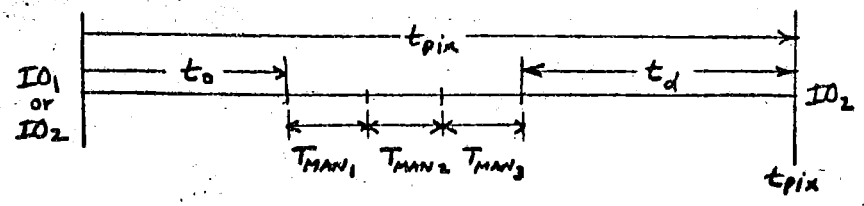
FRAME (106)

MAN. ORDER RPY

MAN. ANGLES° 50.92
18.58
23.51

ROLL	PITCH	YAW
$DR_\phi = \pm .0316°$	$DR_\theta = \pm .1245°$	$DR_\psi = \pm$ $^{+.0687}_{-.1249}$
$LS_{T/L_\phi} = \pm$	$LS_{T/L_\theta} = \pm$	$LS_{T/L_\psi} = \pm$
$RIM(t_{pix}-T_{MAN_\phi}) = \pm .0155°$	$RIM(t_{pix}-T_{MAN_\theta}) = \pm 0.°$	$RIM(t_{pix}-T_{MAN_\psi}) = \pm 0.°$
$T_{MAN_\phi} = 108.90$ sec.	$T_{MAN_\theta} = 39.52$ sec	$T_{MAN_\psi} = 49.67$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

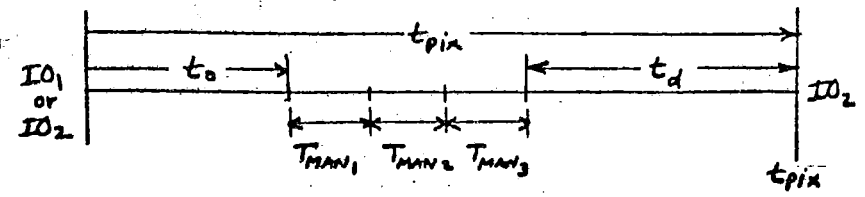
FRAME 1071

MAN. ORDER R P Y

MAN. ANGLES ° −19.50
1.22
−33.70

ROLL	PITCH	YAW
$DR_\phi = \pm .0192°$	$DR_\theta = \pm .0203°$	$DR_\psi = \pm$ $+.0125$ $-.0314°$
$LS_{T/L_\phi} = \pm$	$LS_{T/L_\theta} = \pm$	$LS_{T/L_\psi} = \pm$
$RIM(t_{pin}-T_{MAN_\phi}) = \pm .00202°$	$RIM(t_{pin}-T_{MAN_\theta}) = \pm .00302°$	$RIM(t_{pin}-T_{MAN_\psi}) = \pm .0114°$
$T_{MAN_\phi} = 42.79$ sec.	$T_{MAN_\theta} = 4.80$ sec	$T_{MAN_\psi} = 70.07$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 108

MAN. ORDER RPY

MAN. ANGLES ° -28.34

-12.55

0.

ROLL

$DR_\phi = \pm .0287°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .00189°$

$T_{MAN_\phi} = 60.46$ sec.

PITCH

$DR_\theta = \pm .0133°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm .00279°$

$T_{MAN_\theta} = 27.46$ sec

YAW

$DR_\psi = \pm .0238°$

$LS_{T/L_\psi} = \pm$ °

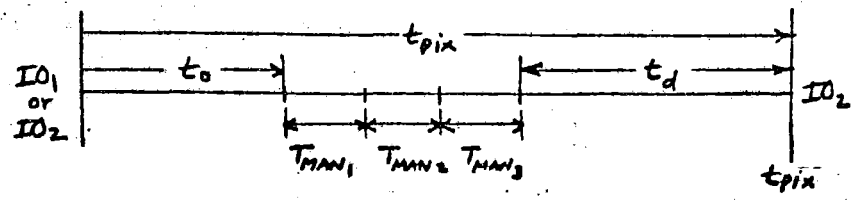
$RIM(t_{pin} - T_{MAN_\psi}) = \pm .0118°$

$T_{MAN_\psi} = 0.$ sec.

108

MANEUVER DATA SHEET

D2 100814 3



IO_1 ☐ IO_2 ☑

MISSION TV

FRAME 109

MAN. ORDER R P Y

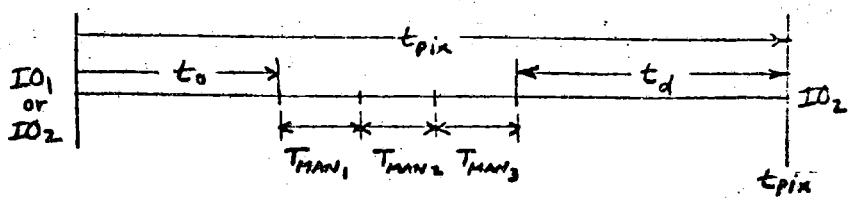
MAN. ANGLES° -30.43

-3.58

0.

ROLL	PITCH	YAW
$DR_\phi = \pm .0232°$	$DR_\theta = \pm .0141°$	$DR_\psi = \pm .0222°$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pin}-T_{MAN_\phi}) = \pm .00173°$	$RIM(t_{pin}-T_{MAN_\theta}) = \pm .00263°$	$RIM(t_{pin}-T_{MAN_\psi}) = \pm .0109°$
$T_{MAN_\phi} = 6.464$ sec.	$T_{MAN_\theta} = 9.51$ sec.	$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME (118)

MAN. ORDER R P Y

MAN. ANGLES ° 51.35
19.10
22.62

ROLL

$DR_\phi = \pm .0383°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0635°$

$T_{MAN_\phi} = 110.09$ sec.

PITCH

$DR_\theta = \pm .0504°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.$ °

$T_{MAN_\theta} = 40.56$ sec.

YAW

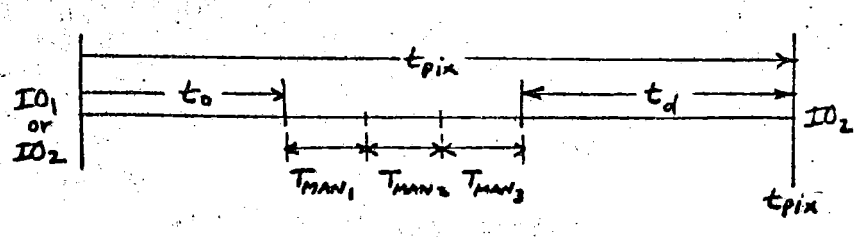
$DR_\psi = \pm$ $^{+.0500}_{-.0634}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.$ °

$T_{MAN_\psi} = 47.91$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME (119)

MAN. ORDER R P Y

MAN. ANGLES ° −19.50

1.22

−33.69

ROLL

$DR_\phi = \pm .0267°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00135°$

$T_{MAN_\phi} = 42.79$ sec.

PITCH

$DR_\theta = \pm$ $\pm .0214$ $\pm .0352$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00205°$

$T_{MAN_\theta} = 4.80$ sec

YAW

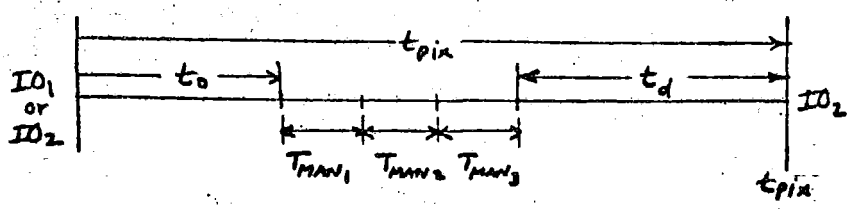
$DR_\psi = \pm$ $\pm .0125$ $\pm .2068$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00754°$

$T_{MAN_\psi} = 70.02$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 120

MAN. ORDER R P Y

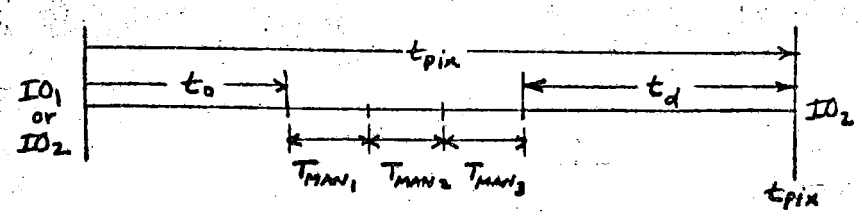
MAN. ANGLES ° −28.33

−12.54

0

ROLL	PITCH	YAW
$DR_\phi = \pm .0307°$	$DR_\theta = \pm .0126°$	$DR_\psi = \pm .0268°$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00094°$	$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00144°$	$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00607°$
$T_{MAN_\phi} = 60.44$ sec.	$T_{MAN_\theta} = 27.26$ sec	$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 121

MAN. ORDER RPY

MAN. ANGLES ° -30.43
-3.59
0.

ROLL

$DR_\phi = \pm .0246°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\phi}) = \pm .00083°$

$T_{MAN_\phi} = 64.64$ sec.

PITCH

$DR_\theta = \pm .0138°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pin} - T_{MAN_\theta}) = \pm .00130°$

$T_{MAN_\theta} = 9.53$ sec

YAW

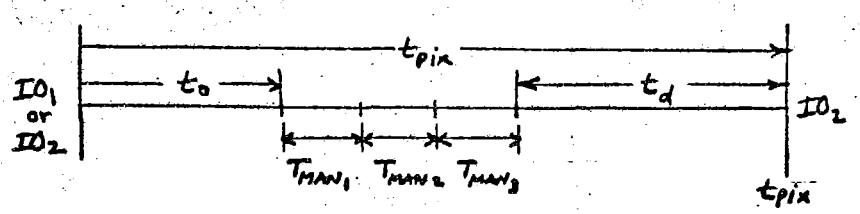
$DR_\psi = \pm .0240°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pin} - T_{MAN_\psi}) = \pm .00540°$

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME (124)

MAN. ORDER R Y P

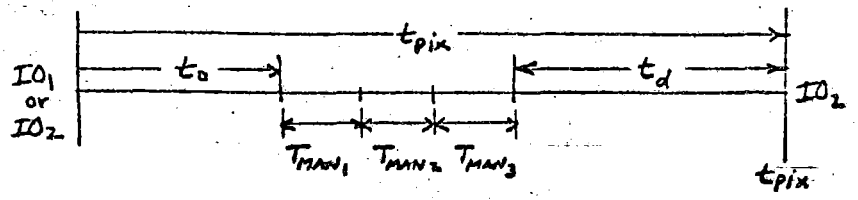
MAN. ANGLES° 31.28

-6.39

12.27

ROLL	PITCH	YAW
$DR_\phi = \pm .0289°$	$DR_\theta = \pm .0348°$	$DR_\psi = \pm .0315°$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pix} - T_{MAN_\phi}) = \pm .610°$	$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °	$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °
$T_{MAN_\phi} = 66.33$ sec	$T_{MAN_\theta} = 26.87$ sec	$T_{MAN_\psi} = 15.44$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 125

MAN. ORDER R P Y

MAN. ANGLES° -28.34

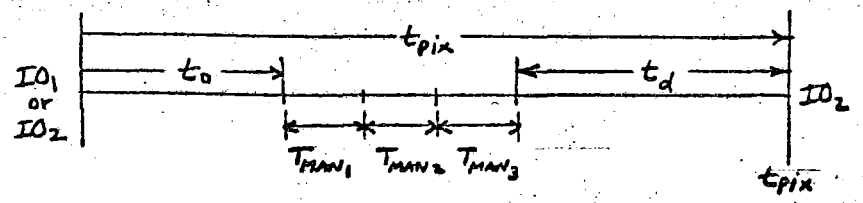
-12.53

0.

ROLL	PITCH	YAW
$DR_\phi = \pm .0360°$	$DR_\theta = \pm .0134°$	$DR_\psi = \pm$ $^{+.0321°}_{-.0127°}$
$LS_{T/L_\phi} = \pm$	$LS_{T/L_\theta} = \pm$	$LS_{T/L_\psi} = \pm$
$RIM(t_{pix}-T_{MAN_\phi}) = \pm .00203°$	$RIM(t_{pix}-T_{MAN_\theta}) = \pm .00300°$	$RIM(t_{pix}-T_{MAN_\psi}) = \pm .0126°$
$T_{MAN_\phi} = 60.76$ sec.	$T_{MAN_\theta} = 27.42$ sec	$T_{MAN_\psi} = 0.$ sec.

125

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME (136)

MAN. ORDER RYP

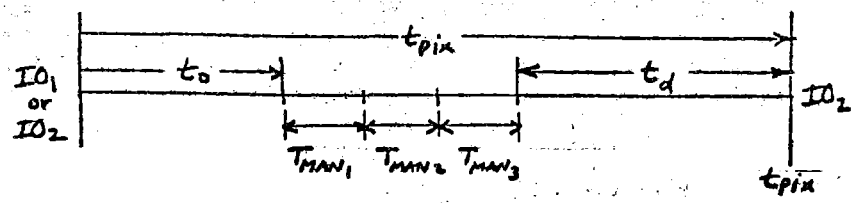
MAN. ANGLES° 31.22

-6.86

13.19

ROLL	PITCH	YAW
$DR_\phi = \pm .0287°$	$DR_\theta = \pm .0405°$	$DR_\psi = \pm .0362°$
$LS_{T/L_\phi} = \pm$ •	$LS_{T/L_\theta} = \pm$ •	$LS_{T/L_\psi} = \pm$ •
$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0554°$	$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00121°$	$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00511°$
$T_{MAN_\phi} = 68.49$ sec	$T_{MAN_\theta} = 28.74$ sec	$T_{MAN_\psi} = 16.39$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 137

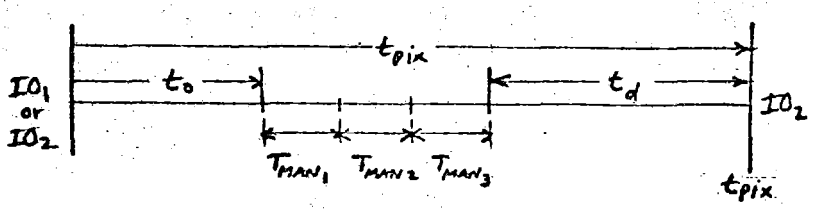
MAN. ORDER RPY

MAN. ANGLES ° -28.29
-12.52
0.

ROLL	PITCH	YAW
$DR_\phi = \pm .0220°$	$DR_\theta = \pm .0166°$	$DR_\psi = \pm .0186°$
$LS_{T/L_\phi} = \pm$ °	$LS_{T/L_\theta} = \pm$ °	$LS_{T/L_\psi} = \pm$ °
$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00106°$	$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00159°$	$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00680°$
$T_{MAN_\phi} = 60.37$ sec.	$T_{MAN_\theta} = 27.42$ sec.	$T_{MAN_\psi} = 0.$ sec.

137

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME (142A)

MAN. ORDER RYP

MAN. ANGLES° 59.86

22.00

22.08

ROLL

$DR_\phi = \pm .044°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .1650°$

$T_{MAN_\phi} = 126.86$ sec

PITCH

$DR_\theta = \pm$ $^{+.054}_{-.238}$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 46.51$ sec

YAW

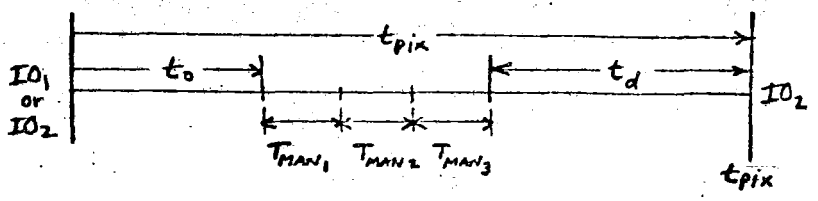
$DR_\psi = \pm .054°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .000268°$

$T_{MAN_\psi} = 46.66$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 142B

MAN. ORDER RPY

MAN. ANGLES° -18.71

1.65

-36.00

ROLL

$DR_\phi = \pm .0222°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00054°$

$T_{MAN_\phi} = 41.21$ sec

PITCH

$DR_\theta = \pm .0354°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00084°$

$T_{MAN_\theta} = 5.66$ sec

YAW

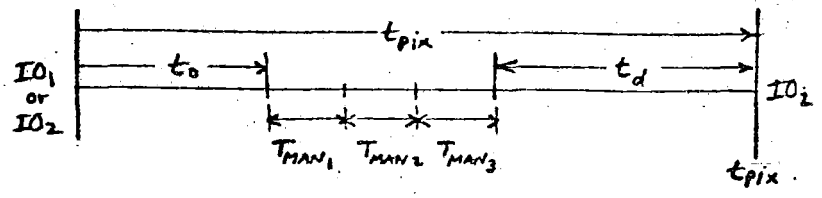
$DR_\psi = \pm .0216°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00295°$

$T_{MAN_\psi} = 74.67$ sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 143

MAN. ORDER R P Y

MAN. ANGLES° −28.27

−12.51

0

ROLL

$DR_\phi = \pm .0266°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0005°$

$T_{MAN_\phi} = 60.31$ sec

PITCH

$DR_\theta = \pm .0131°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0007°$

$T_{MAN_\theta} = 27.37$ sec

YAW

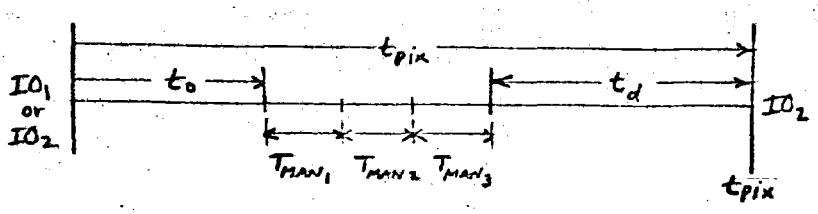
$DR_\psi = \pm .0225°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0032°$

$T_{MAN_\psi} = 0$, sec.

MANEUVER DATA SHEET



IO_1 ☐ IO_2 ☑

MISSION IV

FRAME 144

MAN. ORDER R P Y

MAN. ANGLES° -30.42

-3.62

0.

ROLL

$DR_\phi = \pm .0210°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00171°$

$T_{MAN_\phi} = 64.64$ sec

PITCH

$DR_\theta = \pm .0147°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00259°$

$T_{MAN_\theta} = 9.62$ sec

YAW

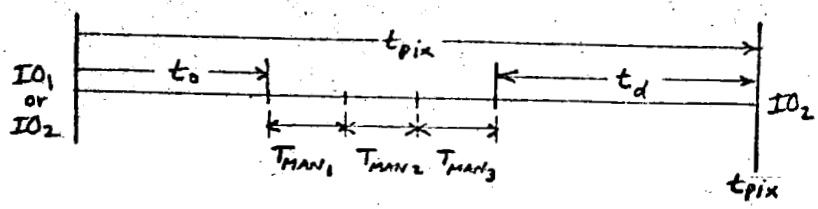
$DR_\psi = \pm .0211°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0107°$

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME 146

MAN. ORDER RYP

MAN. ANGLES° 162.03
-19.07
39.93

ROLL

$DR_\phi = \pm .0317°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm$ .1427 / .0335 °

$T_{MAN_\phi} = 327.85$ sec

PITCH

$DR_\theta = \pm .0403°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00080°$

$T_{MAN_\theta} = 82.22$ sec

YAW

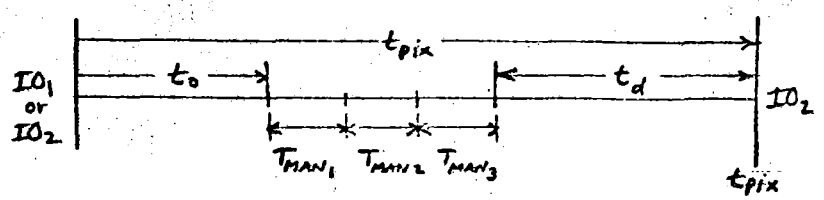
$DR_\psi = \pm .0360°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0032°$

$T_{MAN_\psi} = 40.80$ sec

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME 154

MAN. ORDER R/P

MAN. ANGLES° 60.39
21.13
24.35

ROLL

$DR_\phi = \pm .0439°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0308°$

$T_{MAN_\phi} = 128.99$ sec

PITCH

$DR_\theta = \pm$ $\pm .0508$ $\pm .1520$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 51.07$ sec

YAW

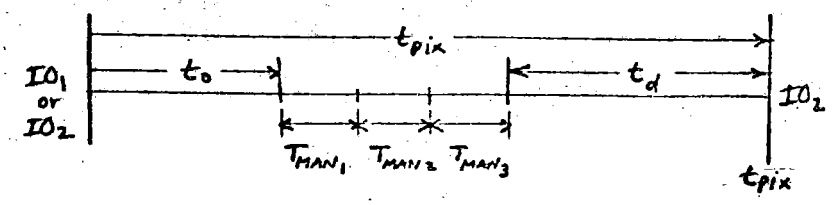
$DR_\psi = \pm .0125°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 99.72$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME 165

MAN. ORDER R P Y

MAN. ANGLES ° -156.26
38.98
0.

ROLL

$DR_\phi = \pm .0423°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0687°$ .0162

$T_{MAN_\phi} = 316.32$ sec

PITCH

$DR_\theta = \pm .0903°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0019°$

$T_{MAN_\theta} = 80.30$ sec

YAW

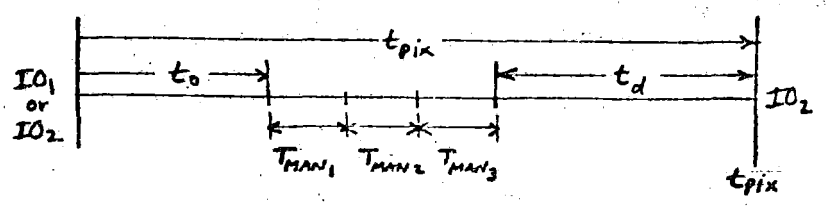
$DR_\psi = \pm .0133°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00166°$

$T_{MAN_\psi} = 0.$ sec

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME 178.

MAN. ORDER RPY

MAN. ANGLES ° 133.15
41.98
0.

ROLL

$DR_\phi = \pm .0334°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0239°$

$T_{MAN_\phi} = 271.88$ sec

PITCH

$DR_\theta = \pm .0699°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00018°$

$T_{MAN_\theta} = 86.32$ sec

YAW

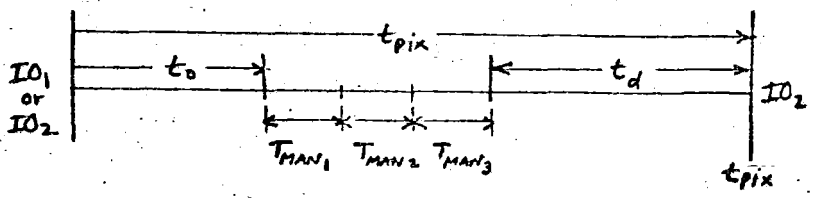
$DR_\psi = \pm .0683°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00172°$

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 21

MAN. ORDER RPY

MAN. ANGLES ° -31.33

170.

0.

ROLL

$DR_\phi = \pm .0304°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0083°$

$T_{MAN_\phi} = 67.19$ sec

PITCH

$DR_\theta = \pm$ $\pm .035$ / $.0418$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 342.37$ sec

YAW

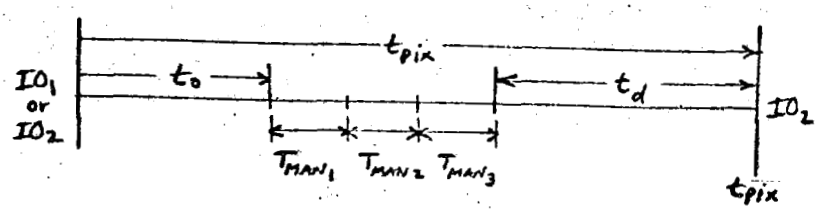
$DR_\psi = \pm .0395°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} =$ 0. sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 22

MAN. ORDER RPY

MAN. ANGLES -20.48

163.78

0.

ROLL

$DR_\phi = \pm .0434°$ ~~.0245°~~

$LS_{T/L_\phi} = \pm$ •

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0217°$

$T_{MAN_\phi} = 45.74$ sec

PITCH

$DR_\theta = \pm .0331°$ ~~.2008°~~

$LS_{T/L_\theta} = \pm$ •

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.0401°$ ~~.0401°~~

$T_{MAN_\theta} = 329.87$ sec

YAW

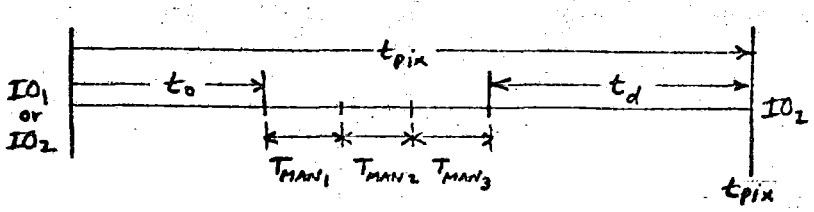
$DR_\psi = \pm .0303°$ ~~.2007°~~

$LS_{T/L_\psi} = \pm$ •

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .000248°$ ~~.0402°~~

$T_{MAN_\psi} = 0.$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 29

MAN. ORDER RPY

MAN. ANGLES° 67.88

-176.97

0.

ROLL

$DR_\phi = \pm .0308°$

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .3227° / .0246$

$T_{MAN_\phi} = 138.19$ sec

PITCH

$DR_\theta = \pm .0466°$

$LS_{T/L_\theta} = \pm$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.°$

$T_{MAN_\theta} = 356.32$ sec

YAW

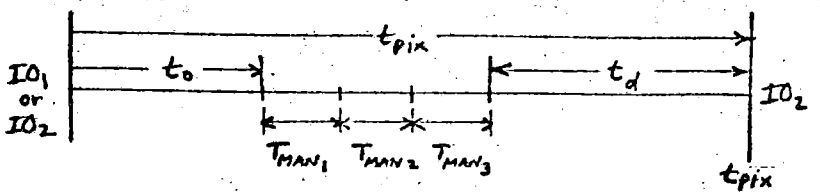
$DR_\psi = \pm .0447°$

$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.°$

$T_{MAN_\psi} = 0.$ sec

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 32

MAN. ORDER RPY

MAN. ANGLES° 32.65

160.03

0.

ROLL

$DR_\phi = \pm$ .0324°

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm$ .0183°

T_{MAN_ϕ} = 67.14 sec

PITCH

$DR_\theta = \pm$ $^{+.0329}_{-.0177}$°

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

T_{MAN_θ} = 322.05 sec

YAW

$DR_\psi = \pm$ .0168°

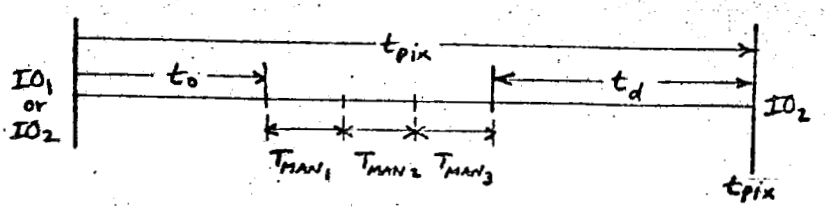
$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

T_{MAN_ψ} = 0. sec.

MANEUVER DATA SHEET

D2 100814 3



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 34

MAN. ORDER R P Y

MAN. ANGLES° 50.55
-8.85
-71.00

ROLL

$DR_\phi = \pm .0423°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00592°$

$T_{MAN_\phi} = 102.14$ sec

PITCH

$DR_\theta = \pm$ ~~.0365~~ .0157°

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00019°$

$T_{MAN_\theta} = 19.55$ sec

YAW

$DR_\psi = \pm .0254°$

$LS_{T/L_\psi} = \pm$ °

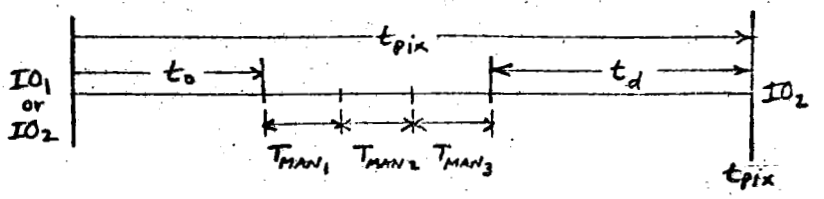
$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00012°$

$T_{MAN_\psi} = 141.29$ sec.

SD 2-7837-0-1 3-68

37

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 37

MAN. ORDER R P Y

MAN. ANGLES° 42.09
−16.80
−68.83

ROLL

$DR_\phi = \pm$ .0474°

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm$ .0238°

$T_{MAN_\phi} = 97.91$ sec

PITCH

$DR_\theta = \pm$ .0378°

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ .0189°

$T_{MAN_\theta} = 35.44$ sec

YAW

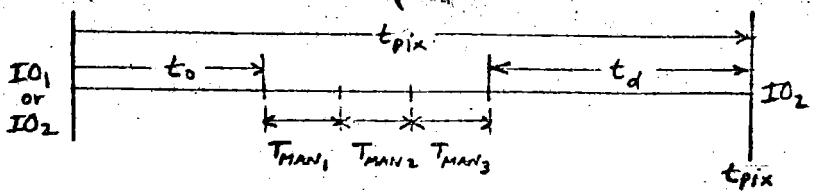
$DR_\psi = \pm$ $^{+.0349}_{-.0205}$°

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ .0174°

$T_{MAN_\psi} = 137.89$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 38

MAN. ORDER R Y P

MAN. ANGLES ° 96.00
-7.90
-67.73

ROLL

$DR_\phi = \pm .0336°$

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0068°$

$T_{MAN_\phi} = 194:23$ sec

PITCH

$DR_\theta = \pm$ +.0472 -.0181°

$LS_{T/L_\theta} = \pm$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0.

$T_{MAN_\theta} = 137:30$ sec

YAW

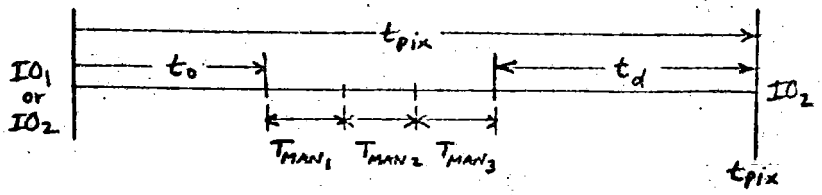
$DR_\psi = \pm$ +.0661 -.0128°

$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0014°$

$T_{MAN_\psi} = 18:03$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 41

MAN. ORDER RYP

MAN. ANGLES° 96.15
-13.35
-62.72

ROLL

$DR_\phi = \pm .0395°$

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0124°$

$T_{MAN_\phi} = 193.33$ sec

PITCH

$DR_\theta = \pm$ +.1670 -.0131

$LS_{T/L_\theta} = \pm$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ Q.

$T_{MAN_\theta} = 127.40$ sec

YAW

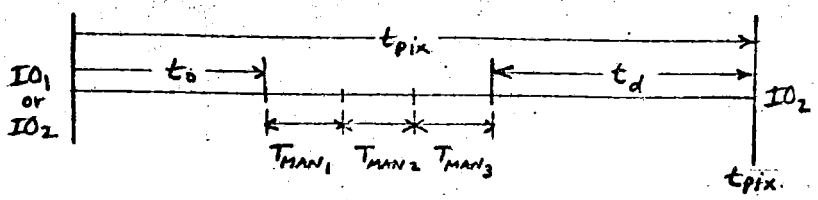
$DR_\psi = \pm .0126°$

$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ Q.

$T_{MAN_\psi} = 249.93$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 42

MAN. ORDER R Y P

MAN. ANGLES ° 91.84
-16.89
-67.37

ROLL

$\begin{cases} DR_\phi = \pm .0279^\circ \\ LS_{T/L_\phi} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0078^\circ$

$T_{MAN_\phi} = 191.33$ sec

PITCH

$\begin{cases} DR_\theta = \pm \overset{\pm .0518}{\pm .0270}^\circ \\ LS_{T/L_\theta} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.$

$T_{MAN_\theta} = 136.57$ sec

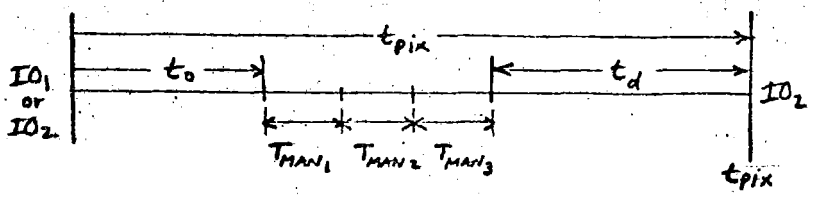
YAW

$\begin{cases} DR_\psi = \pm \overset{\pm .0289}{\pm .0125}^\circ \\ LS_{T/L_\psi} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.$

$T_{MAN_\psi} = 36.09$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 45

MAN. ORDER RPY

MAN. ANGLES ° 31.90

-22.02

-73.76

ROLL

$DR_\phi = \pm .0330°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00830°$

$T_{MAN_\phi} = 66.12$ sec

PITCH

$DR_\theta = \pm .0452°$ $-.0323°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00018°$

$T_{MAN_\theta} = 45.89$ sec

YAW

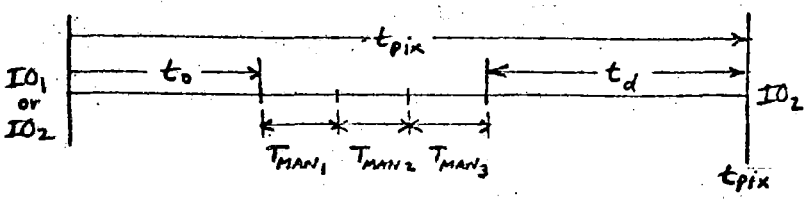
$DR_\psi = \pm .0534°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00012°$

$T_{MAN_\psi} = 149.76$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 49

MAN. ORDER RPY

MAN. ANGLES ° 26.67
5.12
−84.94

ROLL

$DR_\phi = \pm .0294°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0053°$

$T_{MAN_\phi} = 56.42$ sec

PITCH

$DR_\theta = \pm$ $^{+.0623}_{-.0317}$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 12.16$ sec

YAW

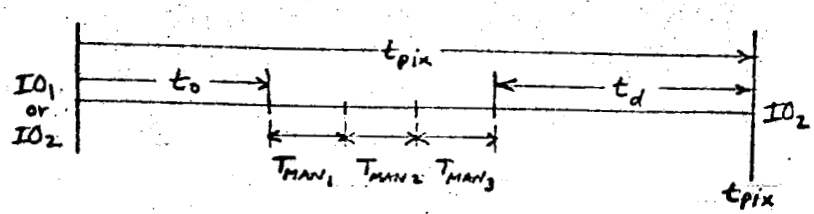
$DR_\psi = \pm .0676°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 172.12$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 52

MAN. ORDER RYP

MAN. ANGLES° 92.86
-16.61
-68.63

ROLL

$DR_\phi = \pm .0356°$

$LS_{T/L_\phi} = \pm$ •

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0121°$

$T_{MAN_\phi} = 188.58$ sec

PITCH

$DR_\theta = \pm$ $^{+.0696}_{-.0196}$ •

$LS_{T/L_\theta} = \pm$ •

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.$ •

$T_{MAN_\theta} = 139.10$ sec

YAW

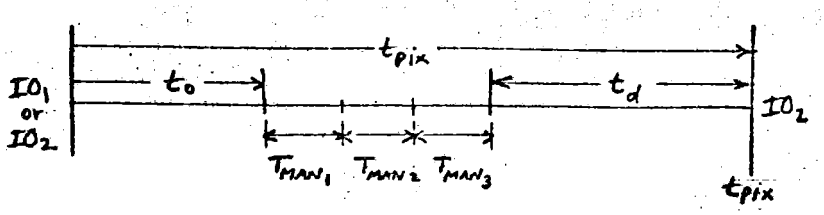
$DR_\psi = \pm$ $\pm .0794$ •

$LS_{T/L_\psi} = \pm .0125°$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.$ •

$T_{MAN_\psi} = 35.45$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 54

MAN. ORDER RYP

MAN. ANGLES° 68.54°
-33.56
-71.47

ROLL

$DR_\phi = \pm .0378°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0381°$

$T_{MAN_\phi} = 139.34$ sec

PITCH

$DR_\theta = \pm .1058°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 144.78$ sec

YAW

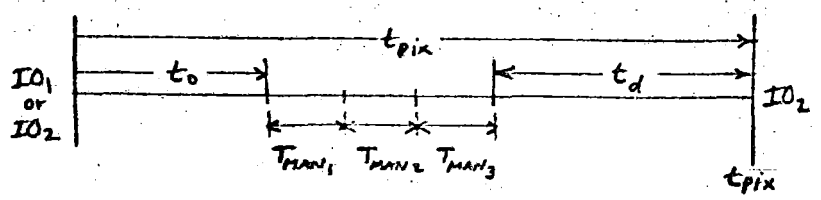
$DR_\psi = \pm .0318°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 69.35$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 56

MAN. ORDER R P Y

MAN. ANGLES ° 29.54
-25.47
-73.58

ROLL

$DR_\phi = \pm .0387°$

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00015°$

$T_{MAN_\phi} = 64.12$ sec

PITCH

$DR_\theta = \pm$ ~~$\pm .0703$~~ $\pm .0125$

$LS_{T/L_\theta} = \pm$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00018°$

$T_{MAN_\theta} = 52.76$ sec

YAW

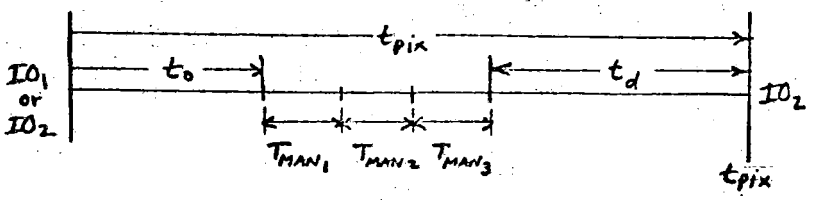
$DR_\psi = \pm$ ~~$\pm .0922$~~ $\pm .0214°$

$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00012°$

$T_{MAN_\psi} = 149.39$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME 60

MAN. ORDER RPY

MAN. ANGLES° 24.14
2.94
-85.32

ROLL

$DR_\phi = \pm .0398°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0507°$

$T_{MAN_\phi} = 50.33$ sec

PITCH

$DR_\theta = \pm .0518°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 7.72$ sec

YAW

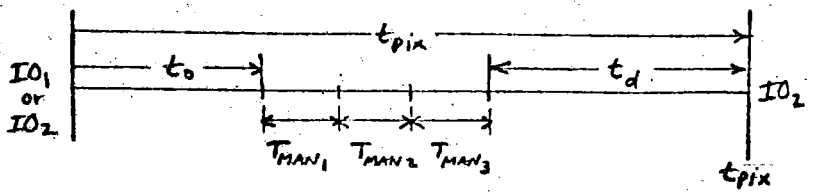
$DR_\psi = \pm .0532°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 177.89$ sec

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION IV

FRAME 63

MAN. ORDER RPY

MAN. ANGLES° 26.28
9.84
-87.12

ROLL

$DR_\phi = \pm .0335°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00335°$

$T_{MAN_\phi} = 55:32$ sec

PITCH

$DR_\theta = \pm .0726°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 21:51$ sec

YAW

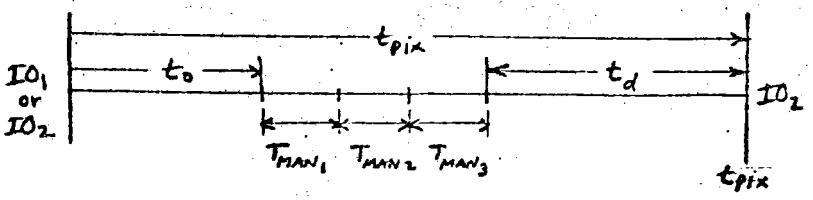
$DR_\psi = \pm .0743°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 176:47$ sec

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 64

MAN. ORDER RYP

MAN. ANGLES ° 94.34
-17.99
-67.89

ROLL

$DR_\phi = \pm .0320°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00731°$

$T_{MAN_\phi} = 191.33$ sec

PITCH

$DR_\theta = \pm .0366°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .000121°$

$T_{MAN_\theta} = 137.52$ sec

YAW

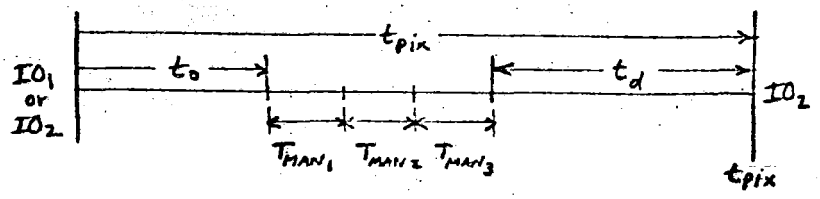
$DR_\psi = \pm$ $^{+.0152}_{-.0125}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .000177°$

$T_{MAN_\psi} = 38.21$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 72

MAN. ORDER RPY

MAN. ANGLES ° 30.03
-20.13
-25.69

ROLL

$DR_\phi = \pm .0275°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00820°$

$T_{MAN_\phi} = 62.97$ sec

PITCH

$DR_\theta = \pm .0339°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .000184°$

$T_{MAN_\theta} = 42.10$ sec

YAW

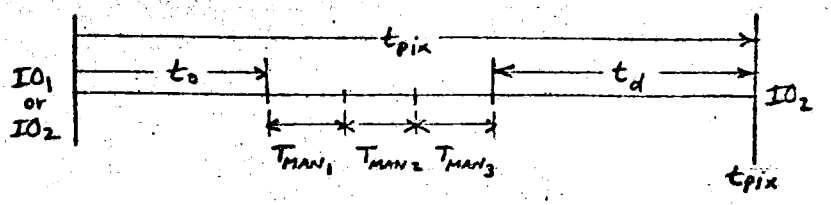
$DR_\psi = \pm$ ° $\pm .0264$ $\pm .0215$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .000122°$

$T_{MAN_\psi} = 153.61$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 76

MAN. ORDER RPY

MAN. ANGLES° 25.71
7.22
−86.51

ROLL

$\begin{cases} DR_\phi = \pm .0337^\circ \\ LS_{T/L_\phi} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0532^\circ$

$T_{MAN_\phi} = 53.15$ sec

PITCH

$\begin{cases} DR_\theta = \pm {}^{+.0674}_{-.0263}{}^\circ \\ LS_{T/L_\theta} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.^\circ$

$T_{MAN_\theta} = 16.28$ sec

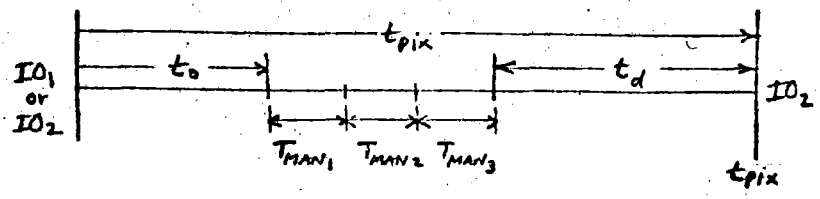
YAW

$\begin{cases} DR_\psi = \pm {}^{+.0739}_{-.0682}{}^\circ \\ LS_{T/L_\psi} = \pm \end{cases}$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm 0.^\circ$

$T_{MAN_\psi} = 175.25$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 91

MAN. ORDER R P Y

MAN. ANGLES 12.01
-27.43
-79.78

ROLL

$DR_\phi = \pm .0284°$

$LS_{T/L_\phi} = \pm$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00355°$

$T_{MAN_\phi} = 26.79$ sec

PITCH

$DR_\theta = \pm .0429°$

$LS_{T/L_\theta} = \pm$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00819°$

$T_{MAN_\theta} = 56.68$ sec

YAW

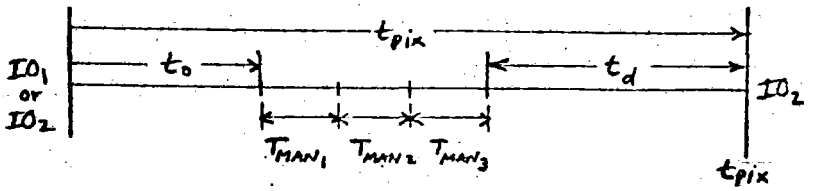
$DR_\psi = \pm .0426°$

$LS_{T/L_\psi} = \pm$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00813°$

$T_{MAN_\psi} = 161.22$ sec

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 102

MAN. ORDER R Y P

MAN. ANGLES° 85.86

-23.22

-119.34

ROLL

$\begin{cases} DR_\phi = \pm .0305^\circ \\ LS_{T/L_\phi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00856^\circ$

$T_{MAN_\phi} = 173.73$ sec.

PITCH

$\begin{cases} DR_\theta = \pm \ ^{+.0713}_{-.0524}{}^\circ \\ LS_{T/L_\theta} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm \ 0.$ °

$T_{MAN_\theta} = 241.52$ sec

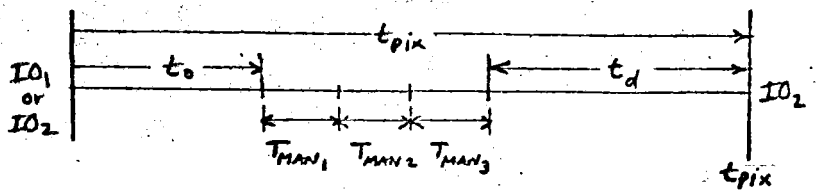
YAW

$\begin{cases} DR_\psi = \pm \ ^{+.0684}_{-.0205}{}^\circ \\ LS_{T/L_\psi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00020^\circ$

$T_{MAN_\psi} = 48.69$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 103

MAN. ORDER R P Y

MAN. ANGLES ° 48.29

164.14

0.

ROLL

$DR_\phi = \pm .0276°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00744°$

$T_{MAN_\phi} = 100.14$ sec

PITCH

$DR_\theta = \pm$ ~~.0527~~ .0186°

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm 0.$ °

$T_{MAN_\theta} = 330.13$ sec

YAW

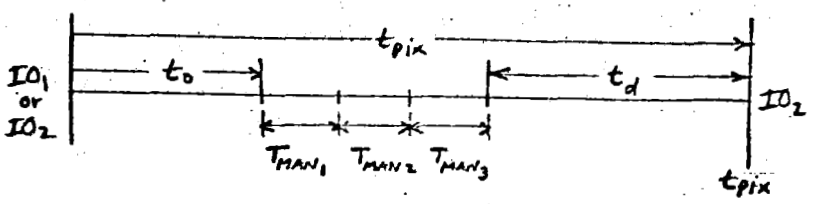
$DR_\psi = \pm .0125°$

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00022°$

$T_{MAN_\psi} = 0.$ sec

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 109

MAN. ORDER RPY

MAN. ANGLES° 32.21
-24.57
-73.30

ROLL

$DR_\phi = \pm .0382°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0722°$

$T_{MAN_\phi} = 66:23$ sec

PITCH

$DR_\theta = \pm .0383°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .00018°$

$T_{MAN_\theta} = 50:98$ sec

YAW

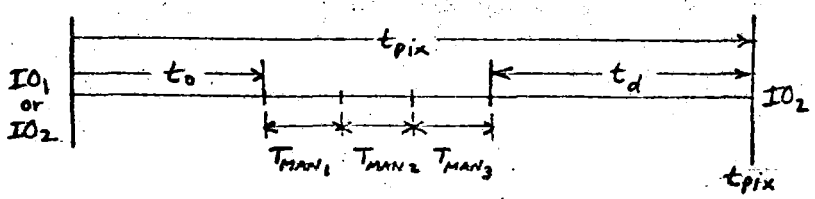
$DR_\psi = \pm$ $\pm .0353$ / $.0379$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .00013°$

$T_{MAN_\psi} = 148.83$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 113

MAN. ORDER RPY

MAN. ANGLES° 26.78
3.13
-84.93

ROLL

$DR_\phi = \pm .0332°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0332°$

$T_{MAN_\phi} = 56.13$ sec

PITCH

$DR_\theta = \pm .0338°$

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 8.08$ sec

YAW

$DR_\psi = \pm$ $^{+.0144°}_{-.0360°}$

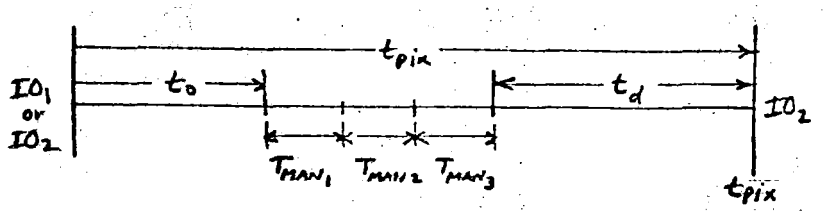
$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 172.07$ sec.

SD 2-7837-0-1 3-68

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 117

MAN. ORDER R P Y

MAN. ANGLES ° 39.31
0.80
−80.42

ROLL

$DR_\phi = \pm .0334$ °

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00221$ °

$T_{MAN_\phi} = 80.93$ sec

PITCH

$DR_\theta = \pm .0302$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 3.55$ sec

YAW

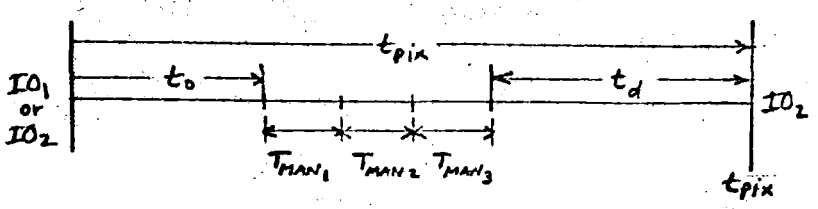
$DR_\psi = \pm .0286$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 163.07$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 130

MAN. ORDER R P Y

MAN. ANGLES -16.18

-13.23

-93.26

ROLL

$DR_\phi = \pm .0300°$

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0048°$

$T_{MAN_\phi} = 37.68$ sec

PITCH

$DR_\theta = \pm$ $^{+.0125}_{-.0576}$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. °

$T_{MAN_\theta} = 28.30$ sec

YAW

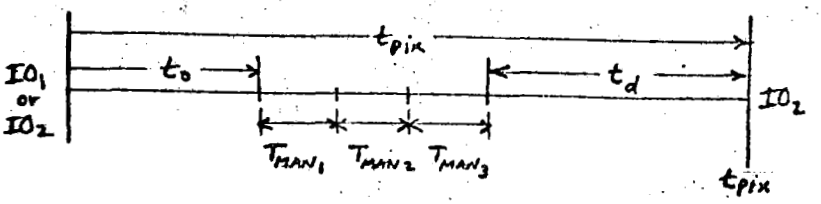
$DR_\psi = \pm$ $^{+.0947}_{-.0706}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. °

$T_{MAN_\psi} = 188.25$ sec.

MANEUVER DATA SHEET



IO_1 ☒ IO_2 ☐

MISSION V

FRAME 168

MAN. ORDER R P Y

MAN. ANGLES° 59.77

-14.29

-69.82

ROLL

$DR_\phi = \pm .1042°$

$LS_{T/L_\phi} = \pm$ •

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0050°$

$T_{MAN_\phi} = 121.94$ sec.

PITCH

$DR_\theta = \pm .0362°$

$LS_{T/L_\theta} = \pm$ •

$RIM(t_{pix} - T_{MAN_\theta}) = \pm$ 0. •

$T_{MAN_\theta} = 30.42$ sec

YAW

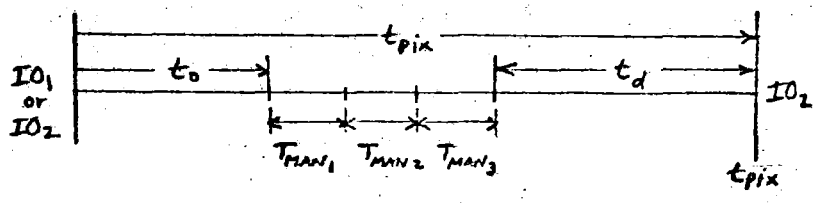
$DR_\psi = \pm {}^{+.1004}_{-.0125}°$

$LS_{T/L_\psi} = \pm$ •

$RIM(t_{pix} - T_{MAN_\psi}) = \pm$ 0. •

$T_{MAN_\psi} = 141.87$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 170

MAN. ORDER RPY

MAN. ANGLES ° 35.17

-19.12

-74.78

ROLL

$DR_\phi = \pm .0291$ °

$LS_{T/L_\phi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .00809$ °

$T_{MAN_\phi} = 72.73$ sec

PITCH

$DR_\theta = \pm {}^{+.0460}_{-.0241}$ °

$LS_{T/L_\theta} = \pm$ °

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .0002$ °

$T_{MAN_\theta} = 40.10$ sec

YAW

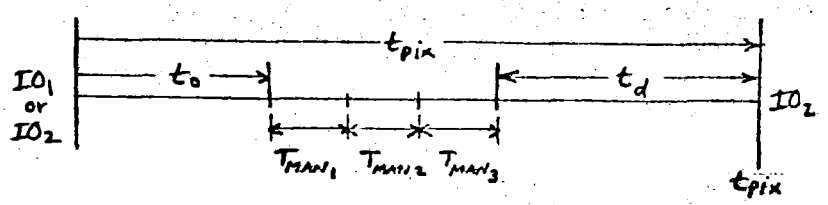
$DR_\psi = \pm {}^{+.0464}_{-.0245}$ °

$LS_{T/L_\psi} = \pm$ °

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .0001$ °

$T_{MAN_\psi} = 151.79$ sec.

MANEUVER DATA SHEET



IO_1 ☑ IO_2 ☐

MISSION V

FRAME 174

MAN. ORDER RPY

MAN. ANGLES° 30.74

4.52

-84.51

ROLL

$\begin{cases} DR_\phi = \pm .0280^\circ \\ LS_{T/L_\phi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\phi}) = \pm .0074^\circ$

$T_{MAN_\phi} = 63.93$ sec.

PITCH

$\begin{cases} DR_\theta = \pm .0723^\circ \\ LS_{T/L_\theta} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\theta}) = \pm .000197^\circ$

$T_{MAN_\theta} = 10.88$ sec

YAW

$\begin{cases} DR_\psi = \pm \quad ^\circ \\ \quad\quad +.0768 \\ \quad\quad -.0738 \\ LS_{T/L_\psi} = \pm \quad ^\circ \end{cases}$

$RIM(t_{pix} - T_{MAN_\psi}) = \pm .000108^\circ$

$T_{MAN_\psi} = 171.25$ sec.

Appendix D

Error Code List

Introduction:

As all frames are not examined for error analysis, representative frames have been investigated such that the errors resulting are applicable to all frames. This is accomplished by the error code number as follows: the error code number, given for each frame, is the frame number examined for error analysis having errors deemed representative of the errors for the frame of interest; error code numbers are given for (and applicable within) each mission.

Frames examined for error analysis were selected giving consideration to parameters directly affecting the photo errors, such as spacecraft altitude, camera axis tilt angle, and attitude maneuver magnitudes, as discussed in Section 2.3.

The error code list is given for each mission below.

Error Code List:

Mission I

Frames	Error Code	Frames	Error Code	Frames	Error Code
5-20	12	113-114	84	22932	32
21-24	22	134	135	31-34	32
52-67	59	135	135	41	42
68-83	75	149	150	42	42
85-100	92	150	150	44	150
105-112	75	151	139	46-47	46
118-133	125	153-156	154	50-51	135
141-148	75	28	28	137	137
157-172	164	30	28	138	139
176-183	179	35-40	28	139	139
184-199	191	115-116	116	140	139
200-215	207	136	28	173	173
48-49	84	25	32	174	174
84	84	26	32	175	175
103	103	27	32		

Appendix D, cont'd

Error Code List, cont'd

Mission II

Frames	Error Code	Frames	Error Code	Frames	Error Code
5-20	141	146-153	141	95	99
35-42	38	154-161	141	112	141
43-50	141	163-170	166	137	137
51-58	141	171-178	174	162	162
59-66	62	179-186	141	195	22
67-74	22	187-194	141	213	162
76-83	79	197-204	200	214	214
84-91	87	205-212	208	215	215
96-103	99	21-24	22	33	33
104-111	141	25-28	26	34	34
113-120	116	29-32	26	75	75
121-128	124	92	26	196	196
129-136	132	93	93		
138-145	141	94	141		

Mission III

Frames	Error Code	Frames	Error Code	Frames	Error Code
5-20	12	185-200	192	107	69
25-32	28	201-204	202	108-111	75
34-36	34	205-212	208	112-115	140
40-43	41	21-24	22	116-119	69
44-51	47	37	37	120	120
52-59	55	38	38	121	121
60-67	63	39	39	122	41
68-71	69	72	72	123	78
86-93	89	'73	73	132-135	140
94-101	97	74-77	75	136	136
124-131	75	78	78	161	161
137-144	140	79	69	162	78
145-152	148	80-83	81	171	171
153-160	156	84	39	172	172
163-170	166	85	38	213	213
173-180	176	102	102	214	213
181-184	182	103-106	41	215	215

Appendix D, cont'd

Error Code List, cont'd

Mission IV

Frames	Error Code	Frames	Error Code	Frames	Error Code	Frames	Error Code
5-8	6	67	22	112	10	156	14
9-12	10	68	42	113	14	157	18
13-16	14	70	6	114	18	158	22
17-20	18	71	10	115	22	160	10
21-24	22	72	14	116	42	161	14
25	25	73	73	118	6	162	18
26	10	74	22	119	10	163	22
27	14	75	75	120	120	164	42
28	18	76	10	121	121	165	165
29	22	77	14	122	22	166	6
30	30	78	18	123	25	167	10
32	6	79	22	124	10	168	14
33	10	80	42	125	125	169	18
34	14	82	6	126	18	170	22
35	18	83	10	127	22	172	10
36	22	84	84	128	42	173	14
38	10	85	85	130	6	174	18
39	14	86	22	131	10	175	22
40	22	88	10	132	14	176	42
41	22	89	14	133	18	177	165
42	42	90	18	134	22	178	178
44	6	91	22	136	10	179	6
45	10	92	42	137	137	180	10
46	14	94	6	138	18	181	14
47	18	95	10	139	22	182	18
48	22	96	14	140	42	183	22
49-51	25	97	18	142	142	184	165
52	10	98	22	143	143	185	165
53	14	99	25	144	144	186	10
54	18	100	10	145	22	187	14
55	22	101	101	146	146	188	18
56	42	102	102	147	146	189	22
58	6	103	22	148	10	190	42
59	10	104	42	149	14	191	165
60	14	106	6	150	18	192	165
61	18	107	10	151	22	193	154
62	22	108	108	152	42	194	10
64	10	109	109	154	154	195	14
65	65	110	22	155	10	196	18
66	66						

Appendix D, cont'd

Error Code List, cont'd

Mission V

Frames	Error Code	Frames	Error Code	Frames	Error Code
5-12	22	55-58	56	125-128	130
13-20	22	59-62	60	129-132	130
21	21	63	63	133-136	117
22	22	64	64	137	117
24	22	65	32	138-141	37
25	29	66-69	37	142-145	91
26	22	70	91	146-149	117
28	22	71-74	72	150-157	37
29	29	75-78	76	158	103
30	22	79	103	159-162	34
31	32	80-83	117	163	103
32	32	84	37	164-167	37
33-36	34	85	103	168	168
37	37	86-89	34	169-172	170
38	38	90-93	91	173-176	174
39	103	94-97	117	177-180	34
40	168	98-101	37	181	103
41	41	102	102	182-185	34
42	41	103	103	186-193	37
43	32	104-107	37	194-201	37
44-47	45	108-111	109	202-205	34
48-51	49	112-115	113	206-209	34
52	52	116-119	117	210-217	91
53	103	120-123	117		
54	54	124	103		

Appendix E

Field of View Error

Introduction:

The field of view uncertainty is shown to be negligible, as it is approximately an order of magnitude less than the camera axis misalignment (which is $> 0.1^{\circ}$, 1σ), and has the same effect on the photo errors. The field of view error, σ_β, may be calculated for a composite worst case for the telephoto (T) and wide-angle (W) lenses from focal length and clamp dimension data given in references 1 and 2.

Calculation of Composite Worst Case σ_β:

The field of view half-angle β is determined by reference to Figure 1 as

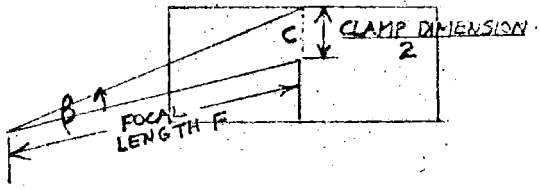


Figure 1, Field of View Half-Angle Determination

$$\beta = \tan^{-1}(C/F) \quad \text{radians.} \qquad (1)$$

The increment in β is

$$\Delta\beta = \frac{\partial\beta}{\partial C}\Delta C + \frac{\partial\beta}{\partial F}\Delta F = \overbrace{\left[\frac{1}{F}\left(\frac{1}{1+\left(\frac{C}{F}\right)^2}\right); -\frac{C}{F^2}\left(\frac{1}{1+\left(\frac{C}{F}\right)^2}\right)\right]}^{S}\begin{bmatrix}\Delta C\\ \Delta F\end{bmatrix}, \qquad (2)$$

so that

$$\sigma_\beta^2 = E(\Delta\beta\,\Delta\beta^T) = S\begin{bmatrix}\sigma_C^2 & 0\\ 0 & \sigma_F^2\end{bmatrix}S^T \quad \text{radians}^2\,; \qquad (3)$$

therefore

$$\sigma_\beta^2 = (57.3)^2(A/F)^2\left[\sigma_C^2 + (C/F)^2\sigma_F^2\right] \quad \text{degrees}^2\,, \qquad (4)$$

where

$$A = \frac{1}{1+\left(\frac{C}{F}\right)^2}\,. \qquad (5)$$

Appendix E, cont'd

Calculation of Composite Worst Case ∇_β, cont'd

A worst-case value for ∇_β is worth examining to see what magnitude of error is involved; it is readily formulated by postulating a composite worst case for the T and W lenses giving greatest ∇_β^2 in equation (4). From references 1 and 2 we have

$$A = 1,$$

$$\nabla_C = .051/3\sqrt{2} \quad \text{mm},$$

$$F = 80 \quad \text{mm},$$

$$C/F = \frac{\frac{219\ \text{mm}}{2}}{80\ \text{mm}} = 1.37,$$

and

$$\nabla_F = .030/3 \quad \text{mm} = .010 \quad \text{mm}.$$

The resulting ∇_β is $.0131^\circ$, a negligible value in relation to the camera axis misalignment uncertainty ($> 0.1^\circ$, 1∇).

References:

1. The Boeing Company Document D2-100814-2, Lunar Orbiter Photo Site Accuracy Analysis - Final Report - Supporting Data.

2. Brown, Duane C., "Calibration of Three High Resolution Lunar Orbiter Cameras", D. Brown Associates, Inc., May 29, 1967; prepared for TBC, Boeing P.O. N-721860-7631.

Appendix F

Rotational Error Due to Manufacturing and Installation of Camera Photo Frame Relative to the Spacecraft

Introduction:

An error in photo frame point locations on the moon arises from rotational error due to manufacturing and installation of the camera photo frame hardware relative to the spacecraft. This rotational error is considered apart from camera axis-to-spacecraft alignment error, discussed in Appendix A. It is shown that the rotational error effect is negligible, including both the telephoto (T) frame rotational error re the spacecraft, and the wide-angle (W) frame rotational error re the telephoto frame.

Worst-Case Errors on the Moon:

For a spacecraft altitude of 57.3 km, the nominal intercepts of the photo frames (T and W) on the moon are given in Figure 1, one degree field of view giving 1 km

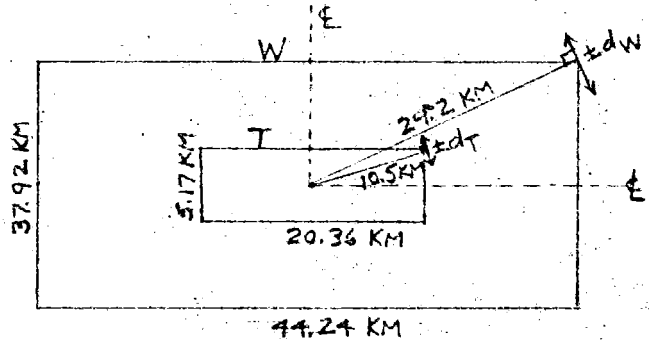


Figure 1, Nominal Field of View Intercepts for 57.3 km Spacecraft Altitude and Zero Tilt Angle; Corresponding Worst-Case Rotational Deviations

distance for zero tilt angle. The rotational errors for this situation cause worst-case deviations $\pm d_T$ and $\pm d_W$ at the corners of the photo frames as indicated. The uncertainties are

$$\nabla_{d_T} = 10.5(\nabla_T^o / 57.3) = 10.5(0.1^o/57.3) = .0184 \text{ km} , \qquad (1)$$

where ∇_T is a conservative appraisal of the telephoto rotational uncertainty re the spacecraft, (and reference 1), and

Appendix F, cont'd

Worst-Case Errors on the Moon, cont'd

$$\nabla_{d_W} = 29.2(\nabla^{o}_{W}/57.3) = (29.2/57.3)\sqrt{(\nabla_T)^2 + (\nabla_{W\ re\ T})^2}$$

$$= (29.2/57.3)\sqrt{(0.1)^2 + (0.0992)^2} = 29.2(0.141^{o}/57.3) = .0722 \text{ km};(2)$$

∇_W is the wide angle rotational uncertainty re the spacecraft, being the root-sum-square of the statistically independent contributions ∇_T and $\nabla_{W\ re\ T}$. The value used for $\nabla_{W\ re\ T}$ in equation (2) is a conservative one for all missions; values of this quantity obtained from photo data are given in Figure 2,

MISSION	$\nabla_{W\ re\ T}$ (°)
II	0.0992
III	0.0646
V	0.0915

Figure 2, Values of $\nabla_{W\ re\ T}$ From Photo Data

from reference 1.

The size of the rotational uncertainties of equations (1) and (2) is now noted relative to conservative attitude errors for a photo corner point for a frame taken as approximately 57.3 km altitude (conservatively 52.9 km, the tilt angle being 4.2°); the attitude errors are examined as they are altitude sensitive, along with rotational error. Taking the errors from Mission III, Frame 202 (page 157), we have the latitude ( ) and longitude ( ) errors of Figure 3:

T Lens	W Lens
= 0.166 km	= 0.130 km
= 0.111 "	= 0.163 "

Figure 3, Conservative Attitude Errors; Mission III, Frame 202, EVAL Corner Point 1. Altitude is 52.9 km; tilt angle 4.2°.

Appendix F, cont'd

Worst-Case Errors on the Moon, cont'd

Assuming conservatively that the σ_{d_T} and σ_{d_W} errors are aligned along the smallest of the errors of Figure 3 for both T and W lenses, the resulting total error becomes

$$\sigma'_{\lambda_{(T)}} = \sqrt{(.112)^2 + (.0184)^2} = 0.113 \text{ km}, \qquad (3)$$

and

$$\sigma'_{u_{(W)}} = \sqrt{(.130)^2 + (.0722)^2} = 0.149 \text{ km}. \qquad (4)$$

The resulting error in the photo errors is

$$2/111_{T} = 1.80\ \% \qquad (5)$$

and

$$19/130_{W} = 14.6\ \% \qquad (6)$$

a small amount for this worst-case analysis.

References:

1. The Boeing Company Document D2-100814-1, Lunar Orbiter Photo Site Accuracy Analysis - Final Report - Photo Site Analysis.

Appendix G

Correlation Coefficients for the Error-Set Frames

Introduction:

For each of the nine photo points examined for each frame (for both telephoto and wide-angle lenses) results have been given in Section 5.0, including standard deviations of total latitude and longitude errors, and the standard deviations of the contributing error sources (navigation, attitude, camera on-time, and moon-radius errors). Also, Appendix H gives, for each point examined, the correlation coefficient, eigenvalues, and associated rotation angle for the total (latitude and longitude) errors.

In addition it is deemed desirable to show for representative error frames (the Error-Set Frames discussed in Section 1.0) computer printouts showing error correlations between the nine points in the frame for both the telephoto and wide-angle lenses for the total errors; these printouts are given below. It is recalled that the Error Set gives representative (and worst-case) error values for all frames examined.

Error-Set Computer Printouts:

Complete sets of covariance matrices $[P_T]$ and $[P_W]$ of photo errors are included in this subsection for the telephoto(T) and wide-angle(W) lenses for the Error-Set Frames. These 18x18 covariance matrices are subdivided into three parts in the printout and labeled as shown in Figure 1, the covariance matrices being symmetrical.

$[P_T]$ or $[P_W]$ subdivision

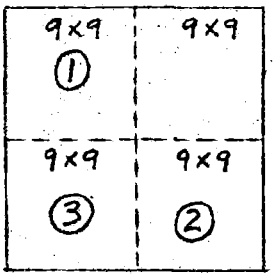


Figure 1, Breakdown of $[P_T]$ and $[P_W]$ Covariance Matrices of Total Photo Errors

MISSION I FRAME 42 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS 1

	0	1	4	12	17
0	.1096784E-02	.1980921E-03	.1026779E-02	.1081889E-02	.1146181E-02
1	.1037540E-02	.1584599E-03	.9725158E-03	.1011978E-02	.1075838E-02
4	.1024779E-02	.1799516E-03	.1345420E-05	.2851010E-04	.3331967E-04
12	.1081189E-02	.2187157E-03	.2851010E-04	.1075939E-02	.1139235E-02
17	.1146181E-02	.2365258E-03	.1072407E-02	.1139235E-02	.1207279E-02
EIGENVALUES	.1097058E-02	.3915138E-03	.3879019E-03	.1135123E-02	.1259830E-02
BETA&RHO	.3580552E-03	.2411813E-00	.3598658E+03	.3436019E+03	.3455614E+03

SQR ROOTS OF DIAG	.3311773E-01	.2031144E-01	.3147223E-01	.2081907E-01	.3101175E-01	.1968261E-01	.3279389E-01	.2111734E-01	.3474592E-01

	17	23	28	34	39
17	.4671274E-03	.2170103E-03	.2403934E-03	.4343746E-03	.3664878E-03
23	.2170103E-03	.1383622E-02	.1310630E-02	.9917576E-03	.2603363E-03
28	.2403934E-03	.1310630E-02	.2586594E-04	.1255700E-02	.2485745E-03
34	.4343746E-03	.9917576E-03	.1255700E-02	.1741622E-02	.1782253E-03
39	.3664878E-03	.2603363E-03	.2485745E-03	.1782253E-03	.3744526E-03
EIGENVALUES	.4671274E-03	.1383622E-02	.2586594E-04	.1255700E-02	.3744526E-03
BETA&RHO	.2719833E-00	.4551383E-03	.1249971E-02	.4344659E-03	.4521817E-03

SQR ROOTS OF DIAG	.2161313E-01	.3719706E-01	.2235260E-01	.3634317E-01	.2109258E-01	.3563723E-01	.2211946E-01	.3369887E-01	.2146326E-01

	17	23	28	34	39
17	.2281071E-03	.4150204E-03	.3519930E-03	.3978171E-03	.4561561E-03
23	.1227221E-02	.2386565E-04	.2589139E-03	.1147758E-02	.2273233E-03
28	.2188547E-03	.4319720E-03	.3693250E-03	.4138501E-03	.4707409E-03
34	.1170239E-02	.9787522E-05	.2176619E-03	.7685018E-05	.1153842E-02
39	.2884716E-04	.4280602E-03	.4093001E-03	.4136588E-03	.2479302E-03
	.1175450E-02	.1487677E-04	.1102941E-02	.2008208E-04	.1114912E-02
	.1952881E-03	.4266652E-03	.4594876E-03	.4165081E-03	.2212019E-03
	.1111149E-02	.4593944E-04	.1716204E-03	.1041325E-02	.2665407E-04

	39
	.1962644E-03
	.4127182E-03
	.1641376E-03
	.4465467E-03
	.1781897E-03
	.4034163E-03
	.2199466E-03
	.3634267E-03
	.2378377E-03

MISSION 1 FRAME 42 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS #

	0	0	1	1	6	6	12	12	17
0	.1519435-02	-.1374692-04	.9917134-03	.7271174-03	.8540710-03	.3428635-04	.1078352-02	-.8240741-03	.1764071-02
0	-.1374692-04	.4361878-03	-.3998543-04	.3769619-03	-.1855505-04	.3780592-03	.6217964-05	.3881190-03	.6140493-04
1	.9917134-03	-.3998543-04	.7044951-03	.4483872-03	.5819537-03	.1817929-04	.6955271-03	-.5147901-03	.1120099-02
1	.7271174-03	.3769619-03	.4483872-03	.7399188-03	.3758725-03	.3773134-03	.4703743-03	-.6349754-04	.8743653-03
6	.8540710-03	-.1855505-04	.5819537-03	.3758725-03	.5011795-03	.7875218-05	.6293059-03	-.4483628-03	.9950891-03
6	.3428635-04	.3780592-03	.1817929-04	.3773134-03	.7875218-05	.3627416-03	.6766968-05	.3304577-03	.7768368-04
12	.1078352-02	.6217964-05	.6955271-03	.4703743-03	.6293059-03	.6766968-05	.8344965-03	-.5707308-03	.1300181-02
12	-.8240741-03	.3881190-03	-.5147901-03	-.6349754-04	-.4483628-03	.3304577-03	-.5707308-03	.8265995-03	-.9086592-03
17	.1764071-02	.6140693-04	.1120099-02	.8743653-03	.9950891-03	.7768368-04	.1300181-02	-.9086592-03	.2100405-02
EIGENVALUES	.1519609-02	.4350135-03	.1170944-02	.2734701-03	.5015962-03	.3623248-03	.1401619-02	.2600270-03	.2454373-02
BETA,RHO	.3692737+03	-.1690542-01	.4613104+02	.6210437-00	.3028433+01	.1872999-01	.3152095+03	-.6869963-00	.3350403+03
SQR ROOTS OF DIAG	.3897993-01	.2086115-01	.2654233-01	.2720145-01	.2238704-01	.1878141-01	.2889544-01	.2875064-01	.4583018-01

	17	23	23	28	28	34	34	39	39
17	.8205119-03	-.1222800-02	.9608092-03	-.1166155-02	.6527786-03	-.1425048-02	.3414367-03	-.9131979-03	.9453582-04
23	-.1222800-02	.5812899-02	-.5439263-03	.4706437-02	.3505671-03	.4897319-02	.1465401-02	.3276167-02	.1517052-02
23	.9608092-03	-.5439263-03	.1352045-02	-.7284953-03	.1076790-02	-.1110540-02	.8484308-03	-.6851367-03	.4610483-03
28	-.1166155-02	.4706437-02	-.7284953-03	.3886128-02	.4248883-04	.4139296-02	.9766655-03	.2760889-02	.1114152-02
28	.6527786-03	.3505671-03	.1076790-02	.4248883-04	.1006886-02	-.2719519-03	.1014741-02	-.1514933-03	.6696971-03
34	-.1425048-02	.4897319-02	-.1110540-02	.4139296-02	-.2719519-03	.4542268-02	.7132509-03	.3032154-02	.9934025-03
34	.3414367-03	.1465401-02	.8484308-03	.9766655-03	.1014741-02	.7132509-03	.1303121-02	.4799727-03	.9744393-03
39	-.9131979-03	.3276167-02	-.6851367-03	.2760889-02	-.1514933-03	.3032154-02	.4799727-03	.2040996-02	.6664174-03
39	.9453581-04	.1517052-02	.4610483-03	.1114152-02	.6696971-03	.9934025-03	.9744393-03	.6664174-03	.7947330-03
EIGENVALUES	.4665444-03	.5878264-02	.1286680-02	.3886754-02	.1006259-02	.4692369-02	.1153021-02	.2330227-02	.6055022-03
BETA,RHO	-.5792890-00	.3531475+03	-.1940207-00	.8452655-00	.2147960-01	.1188421+02	.2931660-00	.2346126+02	.5232565-00
SQR ROOTS OF DIAG	.2864458-01	.7624237-01	.3677017-01	.4233881-01	.3173146-01	.6739635-01	.3609877-01	.4517738-01	.2819101-01

17	-.7290132-03	.4390443-03	-.4745114-03	-.1295595-05	-.3913891-03	.3558927-03	-.4669981-03	.8068724-03	-.7604826-03
23	.2929647-02	.1863697-03	.1842765-02	.1582527-02	.1620019-02	.2252176-03	.2097945-02	-.1452378-02	.3448878-02
23	-.4562375-03	.6909774-03	-.3306111-03	.3077376-03	-.2320799-03	.5532232-03	-.2157406-03	.8707330-03	-.3696037-03
28	.2418741-02	.9598466-05	.1546761-02	.1214963-02	.1332386-02	.8467415-04	.1687230-02	-.1214833-02	.2406621-02

28	.9409595-06	.6490326-03	-.6619776-04	.5385174-03	-.1042006-04	.5384528-03	.6016361-04	.5513063-03	.1491019-03
34	.2588623-02	-.1734725-03	.1709233-02	.1169663-02	.1435349-02	-.3447725-04	.1764021-02	-.1533287-02	.2931306-02
34	.5554007-03	.6549096-03	.2511374-03	.8593949-03	.2610795-03	.5654732-03	.4056950-03	.2149148-03	.7820240-03
39	.1738667-02	-.9542162-04	.1173028-02	.7925536-03	.9802289-03	-.1400537-06	.1194729-02	-.9860269-03	.1968478-02
39	.6562674-03	.4467193-03	.3633270-03	.7463971-03	.3287300-03	.4112339-03	.4489776-03	.6523840-06	.8345646-03

MISSION I FRAME 116 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.5186281-01	.3691793-02	.5250670-01	.8786113-02	.5024991-01	.9036603-02	.5733327-01	-.6213938-03	.5872166-01
0	.3691793-02	.9416213-02	.3524087-02	.1013625-01	.3452626-02	.9345283-02	.4141159-02	.8994578-02	.4488076-02
1	.5250670-01	.3524087-02	.5331330-01	.8310866-02	.5097223-01	.3854924-02	.5810060-01	-.4522000-03	.5941413-01
1	.8786113-02	.1013625-01	.8310866-02	.1240980-01	.8118971-02	.1016818-01	.9552325-02	.8205577-02	.1028989-01
6	.5024991-01	.3452626-02	.5097223-01	.8118971-02	.4875673-01	.3770164-02	.5660328-01	-.4480565-03	.5688285-01
6	.9036603-02	.9345283-02	.3854924-02	.1016818-01	.3770164-02	.9283756-02	.4501740-02	.8822786-02	.4872882-02
12	.5733327-01	.4141159-02	.5810060-01	.9562324-02	.5560328-01	.4501740-02	.6344778-01	-.4055950-03	.6493312-01
12	-.6213937-03	.8994577-02	-.4522000-03	.8205577-02	-.4480564-03	.8822786-02	-.4055949-03	.1006235-01	-.4305909-03
17	.5872166-01	.4488076-02	.5941413-01	.1028989-01	.5688285-01	.4872882-02	.6493312-01	-.4305909-03	.6651965-01
EIGENVALUES	.5218151-01	.9097513-02	.5493743-01	.1078567-01	.4911360-01	.8926883-02	.6345086-01	.1006927-01	.6653219-01
BETA,RHO	.4933931+01	.1670595+00	.1105754+02	.3231068+00	.5407322+01	.1772071+00	.3595647+03	-.1605220-01	.8566758+00
SQR ROOTS OF DIAG	.2277341+00	.9703717-01	.2308987+00	.1113993+00	.2208093+00	.9635224-01	.2518884+00	.1003113+00	.2579140+00

	17	23	23	28	28	34	34	39	39
17	.1031155-01	.8581526-03	.1060812-01	.3809083-03	.9492675-02	.1001051-03	.8776141-02	.3618239-03	.8614673-02
23	.8581527-03	.7093924-01	.2541605-02	.6278055-01	.4753619-02	.6523306-01	.8446969-02	.6332130-01	.9958338-02
23	.1060812-01	.2541605-02	.1095426-01	.1854600-02	.9887413-02	.1613072-02	.9281512-02	.1830894-02	.9138537-02
28	.3809083-03	.6278055-01	.1854600-02	.5559115-01	.3802620-02	.5780084-01	.7387316-02	.5611028-01	.8385189-02
28	.9492675-02	.4753619-02	.9887413-02	.3802620-02	.9823299-02	.3528977-02	.1044917-01	.3466622-02	.1030557-01
34	.1001051-03	.6523306-01	.1613072-02	.5780084-01	.3528977-02	.6015585-01	.7096439-02	.5842367-01	.8153771-02
34	.8776141-02	.8446969-02	.9281513-02	.7387316-02	.1044917-01	.7096439-02	.1265526-01	.6663970-02	.1251947-01
39	.3618238-03	.6332130-01	.1830894-02	.5611028-01	.3466622-02	.5842367-01	.6663970-02	.5679514-01	.7699216-02
39	.8614673-02	.9958338-02	.9138537-02	.8385189-02	.1030557-01	.8153771-02	.1251947-01	.7699216-02	.1240919-01
EIGENVALUES	.1029902-01	.7104674-01	.1084676-01	.5590493-01	.9509509-02	.6119337-01	.1161773-01	.5809272-01	.1111141-01
BETA,RHO	.3205729-01	.2421876+01	.9117447-01	.4717314+01	.1627239-00	.8317907+01	.2571971-00	.9566376+01	.2900141-00
SQR ROOTS OF DIAG	.1015458+00	.2663442-00	.1046626+00	.2357777-00	.9911255-01	.2452669-00	.1124956+00	.2383173-00	.1113966+00

17	.4920789-03	.9208714-02	.6648088-03	.8540539-02	.6266857-03	.9042309-02	.8293781-03	.1017345-01	.8396834-03
23	.6058601-01	.4928496-02	.6118945-01	.1122078-01	.5060937-01	.5342059-02	.6693418-01	-.4587054-03	.6864853-01
23	.9004437-02	.9600009-02	.2084746-02	.9088604-02	.1993591-02	.9439150-02	.2402288-02	.1043396-01	.2460126-02
28	.5366977-01	.3969361-02	.5422661-01	.9514245-02	.5192018-01	.4342627-02	.5926624-01	-.7756630-03	.6076990-01
28	.3545474-02	.9613925-02	.3392471-02	.1026231-01	.3226553-02	.9633541-02	.4001361-02	.9278005-02	.4333404-02
34	.5583158-01	.3708748-02	.5649482-01	.9345607-02	.5406020-01	.4098471-02	.6166548-01	-.1091202-02	.6319001-01
34	.6704950-02	.1032248-01	.6158160-02	.1247892-01	.6077414-02	.1033977-01	.7498614-02	.8477926-02	.7957634-02
39	.5425739-01	.3624113-02	.5498555-01	.8866759-02	.5259605-01	.3986488-02	.5997597-01	-.7944056-03	.6140259-01

39	.7681962-02	.1018503-01	.7169566-02	.1239618-01	.7036323-02	.1020979-01	.8329741-02	.8299913-02	.9054969-02

MISSION 1 FRAME 116 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS M

	0	0	1	1	6	6	12	12	17
0	.6385671-01	.4586513-02	.7361062-01	.5637910-01	.4966901-01	.6564900-02	.1130109+00	-.6076755-01	.1155772+00
0	.4586513-02	.1008100-01	.6702924-02	.1928042-01	.2601295-02	.1205030-01	.2731253-02	.1059945-01	.9224829-02
1	.7361062-01	.6702924-02	.9259930-01	.6123317-01	.6278731-01	.9307649-02	.1366204-00	-.4865030-01	.1338499-00
1	.5637910-01	.1928042-01	.6123317-01	.7886442-01	.3764011-01	.2405091-01	.8505044-01	-.2874625-01	.1027713+00
6	.4966901-01	.2601295-02	.6278731-01	.3764011-01	.4307582-01	.3922551-02	.9404954-01	-.3603111-01	.9029531-01
6	.6564900-02	.1205030-01	.9307649-02	.2405091-01	.3922551-02	.1950704-01	.5018401-02	-.1174311-01	.1285172-01
12	.1130109+00	.2731253-02	.1366204-00	.8505044-01	.9404954-01	.5018601-02	.2105362-00	-.9036256-01	.2049061-00
12	-.6076755-01	.1059945-01	-.4865030-01	-.2874625-01	-.3603111-01	.1176311-01	-.9036256-01	.6926573-01	-.9005706-01
17	.1155772+00	.9224829-02	.1338500-00	.1027713+00	.9029531-01	.1285172-01	.2049061-00	-.9005706-01	.2096207-00
EIGENVALUES	.6924409-01	.9692620-02	.1473489-00	.2411479-01	.4360460-01	.1397826-01	.2545951-00	.2520690-01	.2100982-00
BETA,RHO	.4840241+01	.1807719-00	.4180044+02	.7165431-00	.7677580+01	.1569142-00	.3340071+03	-.7482630-00	.3568334+03
SQR ROOTS OF DIAG	.2526969-00	.1004042+00	.3043013-00	.2808281-00	.2075471-00	.1204452+00	.4588423-00	.2631838-00	.4577343-00

	17	23	23	28	28	34	34	39	39
17	.2141224-01	-.8627081-02	.4719134-01	-.1444752-01	.1791061-01	-.2806103-01	.2319556-01	-.1007180-01	.2859633-02
23	-.8627079-02	.2133012+01	.2219622+01	.5093711-00	.1090884+00	.8035438-00	-.2320950-00	.5158349-00	.1618658-00
23	.4719134-01	.2219622+01	.2447944+01	.4959257-00	.1646992-00	.7650523-00	-.1714494-00	.5112387-00	.1816471-00
28	-.1444752-01	.5093711-00	.4959257-00	.1289692-00	.1452092-01	.2074845-00	-.7134812-01	.1287929-00	.3548356-01
28	.1791061-01	.1090884+00	.1646992-00	.1452092-01	.2999409-01	.9545563-02	.3668710-01	.1101927-01	.2325311-01
34	-.2806103-01	.8035438-00	.7650523-00	.2074845-00	.9545563-02	.3440873-00	-.1480722-00	.2139450-00	.4303970-01
34	.2319556-01	-.2320950-00	-.1714494-00	-.7134812-01	.3668710-01	-.1480722-00	.1485802-00	-.9333623-01	.2674197-01
39	-.1007179-01	.5158349-00	.5112387-00	.1287928-00	.1101927-01	.2139450-00	-.9333623-01	.1362669-00	.2627141-01
39	.2859634-02	.1618658-00	.1816471-00	.3548356-01	.2325311-01	.4303970-01	.2674197-01	.2627141-01	.2956437-01
EIGENVALUES	.2083471-01	.4510691+01	.7026541-01	.1310556-00	.2790766-01	.4237629-00	.6890453-01	.1423845-00	.2344679-01
BETA,RHO	-.1558512-00	.4703352+02	.9691748-00	.8176523+01	.2334713-00	.3317159+03	-.6548754-00	.1310835+02	.4139080-00
SQR ROOTS OF DIAG	.1463292-00	.1460484+01	.1564591+01	.3591228-00	.1731880-00	.5865895-00	.3854610-00	.3691435-00	.1719429-00

17	-.6718032-02	.1038702-01	.1801048-02	.4425819-02	-.1927301-03	.1215999-01	-.9994395-02	.2946533-01	-.1043890-01
23	.3562204-00	.6122591-01	.4052493-00	.3780130-00	.2657975-00	.7863955-01	.6014698-00	-.2421407-00	.6478238-00
23	.3540321-00	.9332929-01	.4253704-00	.4111497-00	.2748193-00	.1644406+00	.5980682-00	-.1747019-00	.6487218-00
28	.8867361-01	.7979081-02	.9602611-01	.8611577-01	.6389594-01	.1106030-01	.1497130-00	-.7480196-01	.1601134-00

28	.6544693-02	.1735166-01	.1229001-01	.3341829-01	.5092736-02	.2065250-01	.6200009-02	.1766244-01	.1720811-01
34	.1464432-00	.4831526-02	.1623331-00	.1255129-00	.1099847+00	.8491492-02	.2562501-00	-.1305929-00	.2638060-00
34	-.6173819-01	.2173665-01	-.7921975-01	-.4345448-02	-.5949303-01	.2460057-01	-.1348190-00	.7505522-01	-.1099767+00
39	.9319565-01	.5918355-02	.1080218+00	.8078153-01	.7299617-01	.8766199-02	.1657178-00	-.7449822-01	.1684996-00
39	.1908556-01	.1351201-01	.1571105-01	.4247498-01	.7478211-02	.1692295-01	.1912424-01	-.5771089-02	.3501321-01

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MISSION I FRAME 137 APOLLO

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	4	4	12	12	17
0	.5285003-04	.2647279-04	.3927983-04	.3306448-04	.4777378-04	.2391700-04	.5911379-04	.1211904-04	.6371658-04
0	.2647278-04	.2499828-03	-.1803933-04	.2245899-03	.2217776-04	.2315488-03	.7524987-04	.2413282-03	.7787646-04
1	.3927983-04	-.1803932-04	.3719280-04	-.7165492-05	.3582436-04	-.1640130-04	.3421037-04	-.2849202-04	.3764942-04
1	.3306647-04	.2245899-03	-.7165497-05	.2052030-03	.2826956-04	.2086965-03	.7499735-04	.2138367-03	.7828012-04
4	.4777378-04	.2217776-04	.3582436-04	.2826957-04	.4322115-04	.1999537-04	.5311617-04	.9312132-05	.5725098-04
4	.2391700-04	.2315488-03	-.1640130-04	.2086965-03	.1999537-04	.2149009-03	.6802469-04	.2236190-03	.7042933-04
12	.5911379-04	.7524987-04	.3421037-04	.7499736-04	.5311617-04	.6802469-04	.7815302-04	.5924647-04	.8321140-04
12	.1211905-04	.2413282-03	-.2849202-04	.2138367-03	.9312133-05	.2236189-03	.5924647-04	.2370623-03	.6051472-04
17	.6371559-04	.7787647-04	.3764942-04	.7828013-04	.5725098-04	.7042934-04	.8321140-04	.6051472-04	.8870376-04
EIGENVALUES	.2534759-03	.4935692-04	.2055080-03	.3688775-04	.2171990-03	.4092307-04	.2567197-03	.5849569-04	.2943070-03
BETA,RHO	.8248319+02	.2303149-00	.2724377+03	-.8202097-01	.8344373+02	.2074732-00	.7164472+02	.4352695-00	.7167499+02
SQR ROOTS OF DIAG	.7269803-02	.1581084-01	.6098590-02	.1432491-01	.6574279-02	.1465950-01	.8840420-02	.1539683-01	.9418267-02

	17	23	23	28	28	34	34	39	39
17	.2717533-03	.7019349-04	.2961638-03	.1869123-04	.2805350-03	-.3658276-04	.2645723-03	-.3321920-04	.2474619-03
23	.7019349-04	.1040426-03	.8101090-04	.7767501-04	.9027738-04	.4948948-04	.1009092-03	.4603489-04	.9211820-04
23	.2961638-03	.8101090-04	.3234933-03	.2340914-04	.3065335-03	-.3839860-04	.2892652-03	-.3479301-04	.2700751-03
28	.1869123-04	.7767501-04	.2340914-04	.6475353-04	.3477876-04	.5104114-04	.4741714-04	.4727775-04	.4305567-04
28	.2805350-03	.9027737-04	.3065335-03	.3477876-04	.2938119-03	-.2482818-04	.2810807-03	-.2239036-04	.2625481-03
34	-.3658276-04	.4948948-04	-.3839859-04	.5104114-04	-.2482818-04	.5294580-04	-.1008947-04	.4884860-04	-.9689551-05
34	.2645724-03	.1009092-03	.2892651-03	.4741714-04	.2810807-03	-.1008948-04	.2732144-03	-.8911235-05	.2552989-03
39	-.3321920-04	.4603489-04	-.3479302-04	.4727775-04	-.2239035-04	.4884860-04	-.8911240-05	.4508975-04	-.8604370-05
39	.2474620-03	.9211819-04	.2700751-03	.4305567-04	.2625481-03	-.9689561-05	.2552989-03	-.8604372-05	.2388927-03
EIGENVALUES	.6615007-04	.3501586-03	.7737724-04	.2989760-03	.5958937-04	.2736756-03	.5248461-04	.2392739-03	.4470848-04
BETA,RHO	.4385967-00	.7178047+02	.4415758-00	.8155409+02	.2521435-00	.2726171+03	-.8388824-01	.2725371+03	-.8290464-01
SQR ROOTS OF DIAG	.1698494-01	.1020013-01	.1798592-01	.8046957-02	.1714094-01	.7276386-02	.1652920-01	.6714890-02	.1545615-01

17	.1506807-04	.2587132-03	-.2956090-04	.2289463-03	.1185784-04	.2393216-03	.6656754-04	.2536120-03	.6809634-04
23	.6980812-04	.8141953-04	.4218971-04	.8267833-04	.6272481-04	.7367068-04	.8992488-04	.6225948-04	.9599223-04
23	.1916011-04	.2821353-03	-.3087598-04	.2493224-03	.1539429-04	.2604704-03	.7651865-04	.2758688-03	.7841574-04
28	.5847927-04	.3129266-04	.4310463-04	.3841041-04	.5282194-04	.2831596-04	.6577424-04	.1528829-04	.7089491-04
28	.2947078-04	.2707555-03	-.1976109-04	.2425205-03	.2474316-04	.2503036-03	.8347916-04	.2612464-03	.8637226-04
34	.4647690-04	-.2255446-04	.4432030-04	-.9177079-05	.4235186-04	-.2040863-04	.3994722-04	-.3512719-04	.4404053-04
34	.4092708-04	.2593600-03	-.7671529-05	.2359555-03	.3512671-04	.2401193-03	.9155571-04	.2462748-03	.9555216-04
39	.4306381-04	-.2038238-04	.4093501-04	-.8197691-05	.3925600-04	-.1848074-04	.3723298-04	-.3195023-04	.4102688-04

39	.3711544-04	.2426523-03	-.7461459-05	.2211732-03	.3180535-04	.2250223-03	.8358016-04	.2306993-03	.8722866-04

MISSION 1 FRAME 137 APOLLO

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS W

	0	0	1	1	6	6	12	12	17
0	.7264191-04	.2998695-04	.2217493-04	.3552690-04	.3566965-04	.1082583-04	.5485522-04	-.2312583-04	.9959746-04
0	.2998695-04	.2533409-03	-.4638011-04	.1462124-03	.2051631-04	.1507757-03	.1144481-03	.1582678-03	.1530772-03
1	.2217493-04	-.4638010-04	.2467237-04	-.1259162-04	.9222699-05	-.2428243-04	-.1172675-04	-.4066042-04	-.3085729-05
1	.3552690-04	.1462124-03	-.1259162-04	.1075882-03	.1752715-04	.9969018-04	.5984581-04	.8920962-04	.9226610-04
6	.3566965-04	.2051632-04	.9222699-05	.1752715-04	.1882207-04	.6875528-05	.3266239-04	-.7665541-05	.5439486-04
6	.1082583-04	.1507757-03	-.2428243-04	.9969018-04	.6875527-05	.1023213-03	.5081999-04	.1064732-03	.6873640-04
12	.5485522-04	.1144481-03	-.1172675-04	.5984581-04	.3266239-04	.5081999-04	.9511040-04	.3911955-04	.1352501-04
12	-.2312582-04	.1582677-03	-.4066042-04	.8920960-04	-.7665539-05	.1064732-03	.3911955-04	.1309720-03	.3721008-04
17	.9959745-04	.1530772-03	-.3085725-05	.9226611-04	.5439486-04	.6873641-04	.1352501-03	.3721009-04	.2062754-03
EIGENVALUES	.2581917-03	.6769862-04	.1094582-03	.2280238-04	.1028837-03	.1625971-04	.1560744-03	.7000805-04	.3817110-03
BETA,RHO	.8082489+02	.2211093-00	.2784473+03	-.2443958-00	.8532410+02	.1566712-00	.5731241+02	.3505020-00	.5658629+02
SQR ROOTS OF DIAG	.8517154-02	.1591692-01	.4967129-02	.1037247-01	.4338441-02	.1011540-01	.9752456-02	.1144430-01	.1436229-01

	17	23	23	28	28	34	34	39	39
17	.3053556-03	.1841613-03	.6996237-03	-.3825172-04	.5272965-03	-.2094434-03	.4121446-03	-.1181190-03	.2316411-03
23	.1841613-03	.9930871-03	.8367339-03	.4844403-03	.7670934-03	.1202025-03	.7839039-03	.6970724-04	.3872356-03
23	.6996237-03	.8367339-03	.1965729-02	.9315082-04	.1481328-02	-.4492243-03	.1196267-02	-.2397202-03	.5983125-03
28	-.3825172-04	.4844403-03	.9315082-04	.3186108-03	.1707969-03	.2027591-03	.2565959-03	.1121077-03	.1320147-03
28	.5272965-03	.7670934-03	.1481328-02	.1707969-03	.1168431-02	-.2717591-03	.9946694-03	-.1485605-03	.5126128-03
34	-.2094434-03	.1202025-03	-.4492243-03	.2027591-03	-.2717591-03	.2734119-03	-.1383706-03	.1516105-03	-.6235492-04
34	.4121446-03	.7839039-03	.1196267-02	.2565959-03	.9946694-03	-.1383707-03	.8982672-03	-.7819400-04	.4709709-03
39	-.1181190-03	.6970724-04	-.2397202-03	.1121077-03	-.1485605-03	.1516105-03	-.7819399-04	.8583883-04	-.3814670-04
39	.2316411-03	.3872356-03	.5983125-03	.1320147-03	.5126128-03	-.6235493-04	.4709708-03	-.3814669-04	.2649174-03
EIGENVALUES	.1299201-03	.2447206-02	.5116108-03	.1201473-02	.2855688-03	.9275375-03	.2441416-03	.2727046-03	.7805158-04
BETA,RHO	.4611602-00	.6008287+02	.5988690-00	.7905092+02	.2799292-00	.2819440+03	-.2792110-00	.2815378+03	-.2529646-00
SQR ROOTS OF DIAG	.1747443-01	.3151328-01	.4433655-01	.1784967-01	.3418232-01	.1653517-01	.2997111-01	.9264925-02	.1627628-01

17	-.1105985-04	.2637902-03	-.6604279-04	.1339487-03	.3182796-06	.1565277-03	.1009345-03	.1891053-03	.1157387-03
23	.2369498-03	.2898451-03	.2004739-04	.1961857-03	.1220927-03	.1302559-03	.2661610-03	.4106418-04	.4360964-03
23	.6361588-04	.6387259-03	-.1337928-03	.3019772-03	.5489007-04	.3305776-03	.3225177-03	.3744207-03	.4248448-03
28	.1507434-03	.5253845-04	.4910409-04	.7447264-04	.7152115-04	.2023411-04	.1030184-03	-.5450251-04	.1969942-03

28	.9362896-04	.5146048-03	-.9076230-04	.2707334-03	.6073887-04	.2735871-03	.2738673-03	.2805779-03	.3795063-03
34	.9039774-04	-.1291616-03	.7676474-04	-.1801940-04	.3612443-04	-.6459551-04	-.2031618-04	.1298885-03	.1984012-04
34	.1299368-03	.4398578-03	-.5746239-04	.2562618-03	.7273674-04	.2367592-03	.2546218-03	.2121183-03	.3738313-03
39	.5020518-04	-.7450900-04	.4472365-04	-.1255623-04	.2043258-04	-.3811888-04	-.1295373-04	.7390579-04	.9651247-05
39	.6612285-04	.2477686-03	-.3009721-04	.1580881-03	.3602956-04	.1472221-03	.1284961-03	.1332603-03	.1884132-03

MISSION I FRAME 154 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	4	4	12	12	17
0	.3733180-04	-.3765440-05	.3909990-04	.3832690-05	.3574492-04	-.2577154-05	.3413960-04	-.1021974-04	.3576976-04
0	-.3765440-05	.1525127-04	-.6334809-05	.1448887-04	-.3945839-05	.1457718-04	-.1236763-05	.1469366-04	-.1208033-05
1	.3909990-04	-.6334809-05	.4699787-04	.2541663-05	.3810903-04	-.3655564-05	.3001634-04	-.1105025-04	.3157849-04
1	.3832690-05	.1448887-04	.2541663-05	.1569226-04	.3369630-05	.1431244-04	.4725103-05	.1268065-04	.5123185-05
4	.3574493-04	-.3945839-05	.3810903-04	.3369630-05	.3431366-04	-.2657111-05	.3207589-04	-.9844219-05	.3360764-04
4	-.2577154-05	.1457718-04	-.3655564-05	.1431244-04	-.2657111-05	.1428664-04	-.1528338-05	.1426619-04	-.1474333-05
12	.3413950-04	-.1236763-05	.3001634-04	.4725103-05	.3207589-04	-.1528338-05	.3672097-04	-.8980708-05	.3832580-04
12	-.1021974-04	.1469366-04	-.1105025-04	.1268065-04	-.9844219-05	.1426619-04	-.8980708-05	.1616287-04	-.9336085-05
17	.3576976-04	-.1208033-05	.3157849-04	.5123185-05	.3360764-04	-.1474333-05	.3832580-04	-.9336085-05	.4001834-04
EIGENVALUES	.3795627-04	.1462681-04	.4720288-04	.1548726-04	.3466020-04	.1394010-04	.4009153-04	.1279230-04	.4266946-04
BETA,RHO	.3505837+03	-.1578059-00	.4611525+01	.9359146-01	.3525695+03	-.1200082+00	.3394283+03	-.3486331-00	.3422361+03
SQR ROOTS OF DIAG	.6109975-02	.3905288-02	.6855499-02	.3961346-02	.5857787-02	.3779768-02	.6059783-02	.4020307-02	.6326005-02

	17	23	23	28	28	34	34	39	39
17	.1683927-04	-.6680127-05	.1747441-04	-.1071624-04	.1607239-04	-.1377066-04	.1439205-04	-.1327080-04	.1373437-04
23	-.6680127-05	.4423452-04	-.7384455-05	.4004917-04	-.8810364-06	.3748810-04	.6960294-05	.3565472-04	.6347637-05
23	.1747441-04	-.7384455-05	.1865245-04	-.1088625-04	.1722434-04	-.1572386-04	.1563609-04	-.1523518-04	.1460259-04
28	-.1071624-04	.4004917-04	-.1088625-04	.4071620-04	-.4612115-05	.4906419-04	.2950940-05	.4226426-04	.3575110-05
28	.1607239-04	-.8810364-06	.1722434-04	-.4612115-05	.1707243-04	-.9322609-05	.1690537-04	-.9164745-05	.1588493-04
34	-.1377066-04	.3748810-04	-.1572386-04	.4906419-04	-.9322609-05	.5477591-04	-.1618417-05	.5289999-04	.5518196-06
34	.1439205-04	.6960294-05	.1563609-04	.2950940-05	.1690537-04	-.1618417-05	.1845561-04	-.1860058-05	.1744829-04
39	-.1327080-04	.3565472-04	-.1523518-04	.4226426-04	-.9164745-05	.5289999-04	-.1860058-05	.5111831-04	.2977571-06
39	.1373437-04	.6347637-05	.1460259-04	.3575110-05	.1588493-04	.5518196-06	.1744829-04	.2977570-06	.1676587-04
EIGENVALUES	.1418815-04	.4620546-04	.1658051-04	.4158402-04	.1620462-04	.5484788-04	.1836363-04	.5112009-04	.1676329-04
BETA,RHO	-.3187772-00	.3450486+03	-.2577757-00	.3493438+03	-.1749318-00	.3574537+03	-.6090160-01	.4965736-00	.1017093-01
SQR ROOTS OF DIAG	.4103560-02	.6650829-02	.4307255-02	.6380924-02	.4131880-02	.7401075-02	.4295999-02	.7149707-02	.4094614-02

17	-.1048540-04	.1528068-04	-.1267602-04	.1299780-04	-.1024579-04	.1452323-04	-.7938421-05	.1634953-04	-.8275200-05
23	.3773767-04	-.1171693-05	.3346361-04	.5605277-05	.3545657-04	-.1407623-05	.4026355-04	-.9763593-05	.4206200-04
23	-.1081961-04	.1603076-04	-.1465403-04	.1341865-04	-.1074368-04	.1487413-04	-.6691592-05	.1661835-04	-.7006316-05
28	.3894457-04	-.3570787-05	.4011399-04	.4315035-05	.3720049-04	-.2483046-05	.3623042-04	-.1058722-04	.3796060-04
28	-.4910347-05	.1596880-04	-.8978714-05	.1471611-04	-.5194116-05	.1491002-04	-.8957710-06	.1515331-04	-.8899157-06
34	.4283103-04	-.6603242-05	.5066001-04	.3132382-05	.4162373-04	-.3844569-05	.3360592-04	-.1216732-04	.3536513-04
34	.2211233-05	.1590771-04	-.2151199-05	.1629468-04	.1491759-05	.1496447-04	.6098610-05	.1339454-04	.6491801-05
39	.4113089-04	-.6479880-05	.4899088-04	.2869116-05	.4002217-04	-.3757513-05	.3197071-04	-.1165734-04	.3364013-04
39	.2952778-05	.1523904-04	-.7986841-08	.1599889-04	.2350213-05	.1464583-04	.5473284-05	.1304748-04	.5868656-05

MISSION 1 FRAME 154 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS #

	0	0	1	1	6	6	12	12	17
0	.5105400-04	-.4277582-05	.4545037-04	.2808939-04	.3238261-04	.2307617-05	.3327228-04	-.2728406-04	.5047226-04
0	-.4277582-05	.1693420-04	-.8602739-05	.1111697-04	-.4050939-05	.1183608-04	.5365592-06	.1269341-04	.1235433-05
1	.4545037-04	-.8602739-05	.7489339-04	.4278844-04	.3469739-04	.2318433-04	.1768799-05	.8620163-06	.1375100-04
1	.2808539-04	.1111697-04	.4278844-04	.4498159-04	.1880596-04	.2962468-04	.4091148-06	.1216995-04	.1123886-04
6	.3238261-04	-.4050939-05	.3469739-04	.1880596-04	.2222946-04	.3904977-05	.1767817-04	-.1317961-04	.2737974-04
6	.2307617-05	.1183608-04	.2318433-04	.2962468-04	.3904977-05	.2874206-04	-.1744520-04	.2790753-04	-.1646581-04
12	.3327228-04	.5365592-06	.1768799-05	.4091148-06	.1767817-04	-.1744520-04	.4690357-04	-.3811084-04	.5958091-04
12	-.2728406-04	.1269341-04	.8620161-06	.1216995-04	-.1317961-04	.2790753-04	-.3811084-04	.4615874-04	-.4844065-04
17	.5047226-04	.1235433-05	.1375100-04	.1123886-04	.2737974-04	-.1646581-04	.5958091-04	-.4844065-04	.7911082-04
EIGENVALUES	.5156758-04	.1542070-04	.1052644-03	.1461057-04	.3057028-04	.2040124-04	.8464382-04	.8418491-05	.8924839-04
BETA,RHO	.3531547+03	-.1499747-00	.3536694+02	.7372033-00	.6491210+02	.1544881-00	.3152799+03	-.8190655-00	.3379611+03
SQR ROOTS OF DIAG	.7145214-02	.3991766-02	.8654097-02	.6706831-02	.4714813-02	.5361162-02	.6048618-02	.6794022-02	.8894426-02

	17	23	23	28	28	34	34	39	39
17	.2738732-04	-.3509764-04	.2903757-04	-.3691248-04	.2141284-04	-.4730249-04	.1259730-04	-.3531088-04	.4953955-05
23	-.3504764-04	.1398562-03	-.2207826-05	.1068045-03	.2171713-04	.9359308-04	.5009746-04	.6300514-04	.3886846-04
23	.2903757-04	-.2207825-05	.5756206-04	-.3026196-04	.5255374-04	-.7271639-04	.4722074-04	-.6215828-04	.1679367-04
28	-.3691248-04	.1068045-03	-.3026196-04	.1002619-03	-.9032520-05	.1182362-03	.1577657-04	.8927222-04	.2709684-04
28	.2141284-04	.2171713-04	.5255374-04	-.9032520-05	.5274108-04	-.4941091-04	.5355750-04	-.4549312-04	.2425378-04
34	-.4730249-04	.9359308-04	-.7271639-04	.1182362-03	-.4941091-04	.1799150-03	-.2272246-04	.1453447-03	.1972468-04
34	.1259730-04	.5009746-04	.4722074-04	.1577657-04	.5355750-04	-.2272246-04	.6164430-04	-.2658903-04	.3327444-04
39	-.3531088-04	.6300514-04	-.6215828-04	.8927222-04	-.4549312-04	.1453447-03	-.2658903-04	.1178553-03	.1225329-04
39	.4953955-05	.3886846-04	.1679367-04	.2709684-04	.2425378-04	.1972468-04	.3327444-04	.1225329-04	.2709623-04
EIGENVALUES	.1724976-04	.1399154-03	.5750287-04	.1019208-03	.5108219-04	.1891309-03	.5744837-04	.1214466-03	.2550490-04
BETA,RHO	-.5380008-00	.3584643+03	-.2460603-01	.3495928+03	-.1242128+00	.3494889+03	-.2157271-00	.7399591+01	.2150155-00
SQR ROOTS OF DIAG	.5233290-02	.1182608-01	.7586967-02	.1001309-01	.7262306-02	.1341324-01	.7852662-02	.1094784-01	.5205404-02

	17	23	28	34	39
17	-.2607130-04	.1597432-04	-.2191837-04	-.4821726-06	-.1601373-04	.1288776-04	-.1700655-04	.2828589-04	-.2504238-04
23	.7222164-04	.2294435-05	.2875217-04	.2498631-04	.3963205-04	-.1517953-04	.7575597-04	-.6144117-04	.1039741-03
23	-.2502499-04	.2264330-04	-.5057521-04	-.1396091-04	-.1977361-04	.3294962-05	.8960851-05	.8845681-05	.3879392-05
28	.7088086-04	-.4200696-05	.5698427-04	.3831029-04	.4319336-04	.9985040-06	.4975994-04	-.4185371-04	.7494147-04
34	-.1074765-04	.2263063-04	-.4133252-04	-.5533754-05	-.1205491-04	.3355713-05	.1956650-04	-.9628568-06	.2036341-04
34	.6769156-04	-.1310982-04	.1070715-03	.6516064-04	.5890477-04	.2164925-04	.3048721-04	-.2813885-04	.5841942-04
39	.5839582-05	.2281036-04	-.3113366-04	.4197024-05	-.3222465-05	.3592600-05	.3222522-04	-.1264803-04	.3995930-04
39	.6770049-04	-.1097410-04	.9171737-04	.5449821-04	.4742481-04	.2228674-04	.1699223-04	-.1452017-04	.3738849-04
39	.1681156-04	.1605402-04	.3878690-05	.2234912-04	.7406675-05	.1072553-04	.1772586-04	-.2604013-05	.2697572-04

MISSION I FRAME 175 APOLLO

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.6218521-04	-.1534694-04	.4719418-04	-.1097098-04	.5943306-04	-.1794677-04	.7993821-04	-.2712685-04	.8103085-04
0	-.1534694-04	.2454462-04	-.8729159-05	.2656416-04	-.1499421-04	.2645273-04	-.2326843-04	.2634575-04	-.2281366-04
1	.4719418-04	-.8729159-05	.3906841-04	-.3392695-05	.4512399-04	-.9653177-05	.5684298-04	-.1787869-04	.5799925-04
1	-.1097098-04	.2656416-04	-.3392695-05	.3065045-04	-.1090140-04	.2901909-04	-.2005723-04	.2692026-04	-.1922381-04
6	.5943306-04	-.1499420-04	.4512399-04	-.1090140-04	.5682376-04	-.1748979-04	.7638931-04	-.2616021-04	.7741395-04
6	-.1794677-04	.2645273-04	-.9653177-05	.2901909-04	-.1748979-04	.2882176-04	-.2785226-04	.2860631-04	-.2732008-04
12	.7993821-04	-.2326843-04	.5684298-04	-.2005723-04	.7638931-04	-.2785226-04	.1072764-03	-.3812591-04	.1082039-03
12	-.2712685-04	.2634575-04	-.1787869-04	.2692026-04	-.2616021-04	.2860631-04	-.3812591-04	.3086450-04	-.3798840-04
17	.8103085-04	-.2281366-04	.5799925-04	-.1922381-04	.7741395-04	-.2732008-04	.1082039-03	-.3798840-04	.1093665-03
EIGENVALUES	.6764931-04	.1908051-04	.4026553-04	.2945333-04	.6522635-04	.2041917-04	.1230453-03	.1509565-04	.1209030-03
BETA,RHO	.3404023+03	-.3928260-00	.3405645+03	-.9804230-01	.3343391+03	-.4321748-00	.3375300+03	-.6625802-00	.3410876+03
SQR ROOTS OF DIAG	.7885760-02	.4954252-02	.6250473-02	.5536285-02	.7538154-02	.5368590-02	.1035743-01	.5555582-02	.1046785-01

	17	23	23	28	28	34	34	39	39
17	.2638592-04	-.3209064-04	.2407489-04	-.2418182-04	.2274702-04	-.1633433-04	.2129265-04	-.1613644-04	.2286807-04
23	-.3209064-04	.1120449-03	-.2530426-04	.8602661-04	-.1775331-04	.6250979-04	-.9364434-05	.6109374-04	-.1338619-04
23	.2407489-04	-.2530426-04	.2238135-04	-.1957405-04	.2118157-04	-.1394328-04	.1987005-04	-.1376266-04	.2101203-04
28	-.2418182-04	.8602661-04	-.1957405-04	.6784299-04	-.1286686-04	.5210463-04	-.5417568-05	.5082900-04	-.7958753-05
28	.2274702-04	-.1775331-04	.2118157-04	-.1286686-04	.2132336-04	-.7502734-05	.2149803-04	-.7587839-05	.2269944-04
34	-.1633433-04	.6250979-04	-.1394328-04	.5210463-04	-.7502734-05	.4436390-04	-.3529037-06	.4311308-04	-.1317337-05
34	.2129265-04	-.9364434-05	.1987005-04	-.5417568-05	.2149803-04	-.3529037-06	.2331916-04	-.7324130-06	.2458592-04
39	-.1613644-04	.6109374-04	-.1376265-04	.5082900-04	-.7587839-05	.4311308-04	-.7324130-06	.4191517-04	-.1714559-05
39	.2286807-04	-.1338619-04	.2101203-04	-.7958753-05	.2269944-04	-.1317337-05	.2458592-04	-.1714559-05	.2617459-04
EIGENVALUES	.1534944-04	.1186931-03	.1573309-04	.7116466-04	.1800170-04	.4436982-04	.2331324-04	.4209976-04	.2599000-04
BETA,RHO	-.5996396-00	.3452792+03	-.5053061-00	.3455248+03	-.3382924-00	.3590396+03	-.1097198-01	.3538550+03	-.5176388-01
SQR ROOTS OF DIAG	.5136722-02	.1058513-01	.4730893-02	.8236686-02	.4617723-02	.6660623-02	.4828992-02	.6474192-02	.5116111-02

17	-.2339572-04	.2453043-04	-.1589802-04	.2483243-04	-.2259644-04	.2635795-04	-.3232582-04	.2840117-04	-.3221207-04
23	.8232564-04	-.2228994-04	.5936525-04	-.1825464-04	.7862836-04	-.2670619-04	.1094029-03	-.3784003-04	.1106538-03
23	-.1898557-04	.2245909-04	-.1354517-04	.2244685-04	-.1838471-04	.2377933-04	-.2548476-04	.2556430-04	-.2539664-04
28	.6494231-04	-.1568465-04	.4927163-04	-.1102275-04	.6204697-04	-.1838762-04	.8348928-04	-.2807955-04	.8465063-04
28	-.1263883-04	.2270932-04	-.7694870-05	.2421380-04	-.1239674-04	.2416272-04	-.1857940-04	.2413083-04	-.1819505-04
34	.4987202-04	-.8473755-05	.4158558-04	-.2455480-05	.4764751-04	-.9323073-05	.5969568-04	-.1834554-04	.6098593-04
34	-.5589403-05	.2300343-04	-.1198986-05	.2618793-04	-.5745346-05	.2460378-04	-.1090634-04	.2255875-04	-.1019350-04
39	.4866624-04	-.8587286-05	.4045231-04	-.2875898-05	.4651121-04	-.9470169-05	.5841095-04	-.1813384-04	.5964091-04

39	-.8028846-05	.2458459-04	-.2202876-05	.2817091-04	-.8082207-05	.2656884-04	-.1504290-04	.2450392-04	-.1427696-04

MISSION 1 FRAME 175 APOLLO

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS W

	0	1	4	12	17
0	.7826322-04	.3668322-04	.5894611-04	.1303845-03	.1410418-03
0	-.1464635-04	.2953647-07	.1587571-04	.4237665-04	.4019127-04
1	.3668322-04	.2953644-07	.2526428-04	.5906318-05	.3731200-04
1	-.5925803-05	.2524428-04	.1006588-03	.6602215-04	.6347973-04
4	.5894611-04	.1587571-04	.4237665-04	.1051321-03	.7445148-04
4	-.3870999-04	.5908317-05	.8628113-04	.3971035-04	.1092929-03
12	.1303845-03	.3731200-04	.6602215-04	.1051321-03	.2644262-03
12	-.9239108-04	.2536892-04	.6347973-04	.7445148-04	.1864255-03
17	.1410418-03	.4939630-04	.1092929-03	.2442624-03	.2750596-03
EIGENVALUES	.8204552-04	.1091194-03	.2274351-04	.1134654-03	.2277634-04
BETA,RHO	.3455202+03	.7209905+02	.4523001-00	.3005666+03	.6155908+00

	0	1	4	12	17
0	.7826322-04	.3668322-04	.5894611-04	.1303845-03	.1410418-03
0	-.1464635-04	.2953647-07	.1587571-04	.4237665-04	.4019127-04
1	.3668322-04	.2953644-07	.2526428-04	.5906318-05	.3731200-04
1	-.5925803-05	.2524428-04	.1006588-03	.6602215-04	.6347973-04
4	.5894611-04	.1587571-04	.4237665-04	.1051321-03	.7445148-04
4	-.3870999-04	.5908317-05	.8628113-04	.3971035-04	.1092929-03
12	.1303845-03	.3731200-04	.6602215-04	.1051321-03	.2644262-03
12	-.9239108-04	.2536892-04	.6347973-04	.7445148-04	.1864255-03
17	.1410418-03	.4939630-04	.1092929-03	.2442624-03	.2750596-03
EIGENVALUES	.8204552-04	.1091194-03	.2274351-04	.1134654-03	.2277634-04
BETA,RHO	.3455202+03	.7209905+02	.4523001-00	.3005666+03	.6155908+00

SQR ROOTS OF DIAG .8846650-02 .6032882-02 .5559147-02 .1004782E-01 .6799249-02 .9987475-02 .1417267-01 .1237735-01 .1654492-01

	17	23	28	34	39
17	.4366373-04	.1491310-04	.9605056-05	.2925118-05	.1274661-04
23	-.8632798-04	.1860825-04	.3292767-04	.5315131-04	.9264893-04
28	-.5443541-04	.1731531-05	.2587237-04	.2119059-04	.1845947-04
28	.9605056-05	.1731531-05	.1196656-03	.8592997-04	.1721701-04
34	-.3541700-04	.1515107-04	.1687567-04	.1854570-04	.4931982-04
34	.2925118-05	.2119059-04	.3033775-04	.2812535-04	.2395224-04
39	-.2818037-04	.1287531-04	.6980017-04	.5942796-04	.2112110-04
39	.1274661-04	.9554853-05	.1721701-04	.1615866-04	.2632495-04
EIGENVALUES	.1666450-04	.2955090-04	.1211788-03	.2257914-04	.8976328-04
BETA,RHO	-.7621563-00	.1909532-00	.8274087+01	.2600476-00	.1642373+02

	17	23	28	34	39
17	.4366373-04	.1491310-04	.9605056-05	.2925118-05	.1274661-04
23	-.8632798-04	.1860825-04	.3292767-04	.5315131-04	.9264893-04
28	-.5443541-04	.1731531-05	.2587237-04	.2119059-04	.1845947-04
28	.9605056-05	.1731531-05	.1196656-03	.8592997-04	.1721701-04
34	-.3541700-04	.1515107-04	.1687567-04	.1854570-04	.4931982-04
34	.2925118-05	.2119059-04	.3033775-04	.2812535-04	.2395224-04
39	-.2818037-04	.1287531-04	.6980017-04	.5942796-04	.2112110-04
39	.1274661-04	.9554853-05	.1721701-04	.1615866-04	.2632495-04
EIGENVALUES	.1666450-04	.2955090-04	.1211788-03	.2257914-04	.8976328-04
BETA,RHO	-.7621563-00	.1909532-00	.8274087+01	.2600476-00	.1642373+02

SQR ROOTS OF DIAG .6607854-02 .1756123-01 .5549116-02 .1093918-01 .4963093-02 .9173637-02 .5331866-02 .7581847-02 .5853092-02

	17	23	28	34	39
17	-.4546557-04	.2601894-04	.1839991-04	.2683601-04	.3546131-04
23	.1526374-03	.2661873-04	.6155645-04	.2022521-04	.1142800-03
28	.2774408-05	.1187700-04	.9882961-05	.3784299-05	.4001684-05
28	.9596454-04	.1363837-04	.4785349-04	.5133790-05	.6933590-04
34	.4535357-04	.8381825-04	.1149233-05	.3803893-04	.1531200-03
39	.8220023-04	.2693286-03	.2271788-04	.1531200-03	.1085509-03
39	.7586251-04	.1881199-03	.2927524-05	.1085509-03	.1694958-03

	17	23	28	34	39
17	-.4546557-04	.2601894-04	.1839991-04	.2683601-04	.3546131-04
23	.1526374-03	.2661873-04	.6155645-04	.2022521-04	.1142800-03
28	.2774408-05	.1187700-04	.9882961-05	.3784299-05	.4001684-05
28	.9596454-04	.1363837-04	.4785349-04	.5133790-05	.6933590-04
34	.4535357-04	.8381825-04	.1149233-05	.3803893-04	.1531200-03
39	.8220023-04	.2693286-03	.2271788-04	.1531200-03	.1085509-03
39	.7586251-04	.1881199-03	.2927524-05	.1085509-03	.1694958-03

	26	34	39
26	.1110805-04	.1333100-04	.1712628-05
34	.6496323-04	.3253610-06	.4920222-04
39	.2244115-04	.1487035-04	.8140058-05
39	.5298740-04	.1649332-06	.4143542-04
39	.8632768-05	.2491727-04	.1403439-04

	26	34	39
26	.8581607-05	.7747364-05	.4316111-05
34	.4212060-04	.4131181-04	.5480894-05
39	.2215616-04	.1351112-04	.9448883-05
39	.3491730-04	.5650093-05	.5770621-04
39	.5292815-04	.1127196-05	.4036840-04

	26	34	39
26	.7747364-05	.4316111-05	.2746683-04
34	.4212060-04	.4131181-04	.5480894-05
39	.2215616-04	.1351112-04	.9448883-05
39	.3491730-04	.5650093-05	.5770621-04
39	.5292815-04	.1127196-05	.4036840-04

0442298

MISSION II FRAME 22 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS I

	0	0	1	1	6	6	12	12	17
0	.4833734-04	.4052282-05	.4580294-04	.1105088-04	.4650698-04	.4245378-05	.4956274-04	-.3463970-05	.5100322-04
0	.4052282-05	.1255172-04	.5703617-05	.1433094-04	.3915034-05	.1315285-04	.2026114-05	.1180334-04	.2355952-05
1	.4580294-04	.5703617-05	.4868638-04	.1455379-04	.4433851-04	.7331973-05	.4129201-04	-.8941898-06	.4287097-04
1	.1105088-04	.1433094-04	.1455379-04	.1917364-04	.1052800-04	.1570856-04	.6522355-05	.1171485-04	.7373560-05
6	.4650698-04	.3915034-05	.4433851-04	.1052800-04	.4480772-04	.4148670-05	.4744399-04	-.3069247-05	.4879447-04
6	.4245378-05	.1315285-04	.7331973-05	.1570856-04	.4148670-05	.1917291-04	.6129353-06	.1240202-04	.1034053-05
12	.4956274-04	.2026114-05	.4129201-04	.6522355-05	.4744399-04	.6129354-06	.5708676-04	-.6008243-05	.5827928-04
12	-.3463970-05	.1180334-04	-.8941898-06	.1171485-04	-.3069247-05	.1240202-04	-.6008243-05	.1316641-04	-.6078073-05
17	.5100322-04	.2355952-05	.4287097-04	.7373560-05	.4879447-04	.1034053-05	.5827928-04	-.6078073-05	.5956766-04
EIGENVALUES	.4879048-04	.1209858-04	.5457324-04	.1320678-04	.4536157-04	.1362106-04	.5789385-04	.1235932-04	.5991390-04
BETA,RHO	.6380409+01	.1645155-00	.2234036+02	.4765847-00	.7576920+01	.1646240-00	.3623493+03	-.2191523-00	.3551302+03
SQR ROOTS OF DIAG	.4952506-02	.3542840-02	.4970393-02	.4381055-02	.4694006-02	.3764692-02	.7555678-02	.3628555-02	.7718009-02

	17	23	23	28	28	34	34	39	39
17	.1221561-04	-.4192153-05	.1186906-04	-.3080633-05	.1117505-04	-.2035812-05	.1029316-04	-.1796685-05	.1053907-04
23	-.4192153-05	.4275791-04	-.1867517-05	.5502338-04	.3973850-05	.4826946-04	.1147930-04	.4666853-04	.1007619-04
23	.1186906-04	-.1867517-05	.1196224-04	-.2214102-05	.1113353-04	-.2864406-05	.1010021-04	-.2597592-05	.9988904-05
28	-.3080633-05	.5502338-04	-.2214103-05	.5212400-04	.4068591-05	.5098721-04	.1206930-04	.4929763-04	.1185016-04
28	.1117505-04	.3973850-05	.1113353-04	.4068591-05	.1183934-04	.4413494-05	.1273979-04	.4276932-05	.1284366-04
34	-.2035812-05	.4826946-04	-.2864406-05	.5098721-04	.4413494-05	.5654637-04	.1360056-04	.5462164-04	.1479318-04
34	.1029316-04	.1147930-04	.1010021-04	.1206930-04	.1273979-04	.1360056-04	.1607816-04	.1296534-04	.1643896-04
39	-.1796685-05	.4666853-04	-.2597592-05	.4929763-04	.4276932-05	.5462164-04	.1296534-04	.6280344-04	.1409759-04
39	.1053907-04	.1007619-04	.9988904-05	.1185016-04	.1284366-04	.1479318-04	.1643896-04	.1409759-04	.1709771-04
EIGENVALUES	.1186937-04	.6282648-04	.1189367-04	.5253080-04	.1193253-04	.6049246-04	.1193207-04	.8769847-04	.1220268-04
BETA,RHO	-.1606530-00	.3578973+03	-.6815916-01	.5709819-01	.1637802-00	.1695371+02	.4610619-00	.1914826+02	.4691856-00
SQR ROOTS OF DIAG	.3495084+02	.7921989-02	.3458646-02	.7219695-02	.3440834-02	.7519732-02	.4009758-02	.7266597-02	.4134937-02

17	-.2791590-05	.1139908-04	-.1515042-05	.1087130-04	-.2496734-05	.1165208-04	-.3761870-05	.1253603-04	-.4063877-05
23	.5271272-04	.2739962-05	.4474596-04	.8376362-05	.5039731-04	.1526643-06	.5969335-04	.4167916-05	.4109539-04
23	-.2030466-05	.1094709-04	-.2282414-05	.9890031-05	-.1841372-05	.1078777-04	-.1551126-05	.1182035-04	-.1692338-05
28	.5016433-04	.4194887-05	.4726529-04	.1157898-04	.4820106-04	.4347740-05	.5167689-04	.3832561-05	.5320728-04
28	.3884033-05	.1198908-04	.9106979-05	.1300455-04	.3704557-05	.1217441-04	.3454421-05	.1123631-04	.3695691-05
34	.4930841-04	.6189744-05	.5230805-04	.1622567-04	.4762522-04	.8002130-06	.4933419-04	-.1366367-05	.4913321-04
34	.1141487-04	.1329701-04	.1217365-04	.1691004-04	.1076504-04	.1390050-04	.9907605-05	.1047635-04	.1062989-04
39	.4771604-04	.5971739-05	.5061792-04	.1544990-04	.4613220-04	.7700686-06	.4295170-04	-.1149200-05	.4465087-04

39	.1125299-04	.1374939-04	.1325510-04	.1792849-04	.1066071-04	.1470356-04	.8376834-05	.1102088-04	.9157438-05

MISSION 11 FRAME 22 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS M

	0	0	1	1	6	6	12	12	17
0	.5977386-04	.5303734-05	.4158744-04	.3087876-04	.4095361-04	.2568420-05	.5675113-04	.2764789-04	.7111182-04
0	.5303734-05	.1297620-04	.7961971-06	.2226896-04	.2591031-05	.1786209-04	.1901342-05	.1312614-04	.1904056-05
1	.4158744-04	.7961971-05	.5277739-04	.4833418-04	.2936988-04	.2816652-04	.1080666-04	.6372716-05	.2299865-04
1	.3087876-04	.2226896-04	.4833418-04	.8414715-04	.1230597-04	.5397107-04	.1763291-04	.2126327-04	.2689493-05
6	.4095361-04	.2591031-05	.2936988-04	.1230597-04	.3177475-04	.1478976-05	.4327860-04	.1610926-04	.4975704-04
6	.2568420-05	.1786209-04	.2816652-04	.5397107-04	.1478976-05	.4585137-04	.3659562-04	.3482067-04	.2756154-04
12	.5675113-04	.1901342-05	.1080666-04	.1763291-04	.4327860-04	.3659562-04	.9460866-04	.6439063-04	.1024737-03
12	.2764789-04	.1312614-04	.6372716-05	.2126327-04	.1610926-04	.3482067-04	.6439063-04	.6321470-04	.5936766-04
17	.7111182-04	.1904056-05	.2299865-04	.2689493-05	.4975704-04	.2756154-04	.1024737-03	.5936766-04	.1153507-03
EIGENVALUES	.6036741-04	.1238264-04	.1192777-03	.1764683-04	.4400508-04	.3162104-04	.1334702-03	.1038314-04	.1202716-03
BETA;RHO	.6385622+01	.1904375-00	.5398936+02	.7252484-00	.2759336+03	.3874751-01	.3258738+03	.7685780-00	.3476087+03
SQR ROOTS OF DIAG	.7731355-02	.3602249-02	.7264805-02	.9173175-02	.5638909-02	.6771364-02	.9828970-02	.7294840-02	.1074014-01

	17	23	23	28	28	34	34	39	39
17	.2000600-04	.2915435-04	.1664241-04	.2508352-04	.9062650-05	.2705421-04	.2494633-07	.1785796-04	.1069954-04
23	.2915435-04	.1560004-03	.1072420-04	.1176323-03	.2985022-04	.9818489-04	.5800799-04	.7072988-04	.4389679-04
23	.1664241-04	.1072420-04	.3759958-04	.1137720-04	.3000953-04	.4048664-04	.2060855-04	.3238994-04	.1138192-04
28	.2508352-04	.1176323-03	.1137720-04	.1061054-03	.9120233-05	.1127166-03	.3801573-04	.8600669-04	.4324411-04
28	.9062650-05	.2985022-04	.3000953-04	.9120233-05	.2840619-04	.1304299-04	.2716665-04	.1210512-04	.1159637-04
34	.2705421-04	.9818489-04	.4048664-04	.1127166-03	.1304299-04	.1540472-03	.2424137-04	.1213068-03	.5352528-04
34	.2494633-07	.5800799-04	.2060855-04	.3801573-04	.2716665-04	.2424137-04	.3711304-04	.1529917-04	.2748332-04
39	.1785796-04	.7072988-04	.3238994-04	.8600669-04	.1210512-04	.1213068-03	.1529917-04	.9750649-04	.4035761-04
39	.1069954-05	.4389679-04	.1138193-06	.4324411-04	.1159637-04	.5352528-04	.2748332-04	.4035761-04	.3502474-04
EIGENVALUES	.1508516-04	.1569640-03	.3663607-04	.1061750-03	.2733663-04	.1588734-03	.3228680-04	.1173022-03	.1522907-04
BETA;RHO	.4623865-00	.5133912-01	.1400266-00	.4688736+01	.1669118-00	.1125983+02	.3206026-00	.2612825-02	.6905915-00
SQR ROOTS OF DIAG	.4472806-02	.1249001-01	.6131850-02	.1025209-01	.5329746-02	.1241157-01	.6092047-02	.9874637-02	.5918170-02

17	.1663280-04	.9871354-06	.6916489-05	.9464773-07	.8057310-05	.1256504-04	.1672960-04	.2412951-04	.2221239-04
23	.8810115-04	.5815407-05	.3704902-04	.2513721-04	.6753730-04	.1911368-04	.1006908-03	.6609240-04	.1310109-03
23	.5685279-05	.8005512-05	.2290353-04	.2303258-04	.5240324-07	.1289487-04	.2435339-04	.1670286-05	.1817942-04
28	.7796241-04	.7731733-05	.5334691-04	.4851419-04	.4985273-04	.6212262-05	.6987567-04	.3901717-04	.9177709-04

28	.7762201-05	.1018582-04	.1137418-04	.5644764-06	.6183713-05	.6722627-06	.2976688-04	.7684302-05	.2992866-04
34	.8130916-04	.1177954-04	.8138638-04	.8846839-04	.4875194-04	.3742727-04	.3673439-04	.1753934-04	.6487337-04
34	.2685394-04	.1316736-04	.3940867-05	.1733821-04	.1510194-04	.7227620-06	.3913629-04	.1686114-04	.4797423-04
39	.6342964-04	.1020957-04	.6848774-04	.7057428-04	.4001001-04	.3340649-04	.2481271-04	.6665910-06	.4589267-04
39	.2908370-04	.1630634-04	.2390178-04	.4613601-04	.1419740-04	.2334166-04	.1482241-04	.1129884-05	.2831354-04

MISSION II FRAME 134 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS I

	0	0	1	1	6	6	12	12	17
0	.8323647-01	.1133211-01	.6835210-01	.1438223-01	.7965133-01	.9276913-02	.1499394-00	.6440434-02	.1494412-00
0	.1133211-01	.1530476-01	.8576257-02	.1993851-01	.1044362-01	.1994746-01	.2024491-01	.1761633-01	.2129917-01
1	.6835210-01	.8576257-02	.5153842-01	.1053999-01	.6270435-01	.6942421-02	.1177979-00	.5330909-02	.1171726-00
1	.1438223-01	.1993851-01	.1053999-01	.1573047-01	.1304046-01	.1456911-01	.2554212-01	.1535727-01	.2697348-01
6	.7966133-01	.1044352-01	.6270435-01	.1304046-01	.7635129-01	.8459621-02	.1435535-00	.6179502-02	.1428869-00
6	.9276913-02	.1494746-01	.6942421-02	.1456911-01	.8459621-02	.1464578-01	.1652672-01	.1718129-01	.1761340-01
12	.1499394-00	.2024491-01	.1177980-00	.2554212-01	.1435535-00	.1652672-01	.2701679-00	.1168369-01	.2691643-00
12	.6440434-02	.1751633-01	.5330909-02	.1535727-01	.6179503-02	.1718129-01	.1168369-01	.2272367-01	.1233697-01
17	.1494412-00	.2129917-01	.1171726-00	.2697348-01	.1428869-00	.1761340-01	.2691643-00	.1233697-01	.2684667-00
EIGENVALUES	(.8507699-01	.1396424-01)	.5441048-01	.1285841-01	(.7749006-01	.1350701-01)	.2707184-00	.2217322-01	(.2712507-00
BETA;RHO	(.9225185-01	.3174978-00)	.1524267-02	.3701722-00	(.7666637-01	.2529802-00)	.2697339-01	.1491146-00	(.6064301-01
SQR ROOTS OF DIAG	.2885073-00	.1237124-00	.2270207-00	.1254212-00	.2763174-00	.1210197-00	.5197768-00	.1507437-00	.5181367-00

	17	23	23	28	28	34	34	39	39
17	.2449450-01	.2727426-01	.2646877-01	.1492009-01	.1944767-01	.1133917-01	.1684951-01	.1134122-01	.1674996-01
23	.2727426-01	.2743297-00	.4454174-01	.1587167-00	.2761789-01	.1232807-00	.3136472-01	.1207671-00	.3020599-01
23	.2646877-01	.4454174-01	.2954428-01	.2488006-01	.2148959-01	.1904639-01	.1918798-01	.1886983-01	.1901042-01
28	.1492009-01	.1587167-00	.2488006-01	.9189863-01	.1513707-01	.7143847-01	.1725804-01	.7001424-01	.1659663-01
28	.1944767-01	.2761789-01	.2148959-01	.1513707-01	.1668936-01	.1133895-01	.1579704-01	.1103311-01	.1664750-01
34	.1133917-01	.1232807-00	.1904639-01	.7143847-01	.1133895-01	.5559935-01	.1281732-01	.5463974-01	.1231625-01
34	.1684951-01	.3136472-01	.1918798-01	.1725804-01	.1579704-01	.1281732-01	.1628392-01	.1221762-01	.1607638-01
39	.1134122-01	.1207671-00	.1886983-01	.7001424-01	.1103311-01	.5463974-01	.1221762-01	.5366101-01	.1173711-01
39	.1674996-01	.3020599-01	.1901042-01	.1659663-01	.1664750-01	.1231625-01	.1607638-01	.1173711-01	.1587638-01
EIGENVALUES	.2170943-01	.2821827-00	.2149130-01	(.9483089-01	.1376710-01)	.5940884-01	.1247444-01	(.6691763-01	.1251976-01
BETA;RHO	.3232760-00)	.9998849-01	.4947593-00	(.1096318-02	.3865161-00)	.1655267-02	.4259736-00	(.1595964-02	.4024956-00)
SQR ROOTS OF DIAG	.1565072-00	.5237650-00	.1718845-00	.3031479-00	.1291873-00	.2357951-00	.1276085-00	.2319325-00	.1260016-00

17	.1415522-01	.1859895-01	.1134818-01	.1679647-01	.1353440-01	.1807635-01	.2557144-01	.2324790-01	.2621514-01
23	.1508249-00	.2278082-01	.1179835-00	.2897285-01	.1439861-00	.1908461-01	.2716328-00	.1322260-01	.2711794-00
23	.2358335-01	.2033386-01	.1867635-01	.1897659-01	.2249867-01	.1958175-01	.4253143-01	.2433676-01	.4321420-01
28	.8739268-01	.1235059-01	.6844149-01	.1588360-01	.8349224-01	.1021034-01	.1573511-00	.6791431-02	.1570286-00
28	.1398985-01	.1595037-01	.1066961-01	.1562566-01	.1299142-01	.1552248-01	.2504227-01	.1811968-01	.2608609-01
34	.6801380-01	.9176745-02	.5337543-01	.1177034-01	.6606636-01	.7607312-02	.1224799-00	.5033205-02	.1221084-00
34	.1566398-01	.1507071-01	.1150206-01	.1599168-01	.1423922-01	.1467239-01	.2784564-01	.1828385-01	.2930350-01
39	.6674416-01	.8904000-02	.5249267-01	.1121008-01	.6392933-01	.7252264-02	.1202436-00	.5171902-02	.1197584-00

39	.1505084-01	.1494104-01	.1104545-01	.1579908-01	.1364939-01	.1455660-01	.2674876-01	.1824575-01	.2818326-01

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MISSION 11 FRAME 34 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS W

	0	1	6	12	17
0	.1017699+00	.1422826-01	.1462880-01	.0000000	.0000000
0	.1422826-01	.1610123-01	.2512063-01	.0000000	.0000000
1	.1462880-01	.2512063-01	.2268486-01	.0000000	.0000000
1	.8948316-01	.7619759-02	.2593163-01	.0000000	.0000000
6	-.7419670-02	.1956727-01	.2553742-01	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000
17	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.1040712+00	.1379995-01	.2730346-01	.0000000	.0000000
BETA,RHO	.9187457+01	.3514997-00	.4530409-00	.0000000	.0000000

	17	23	28	34	39
17	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.2172820-00	.1453732-00	.5673070-01
28	.0000000	.0000000	.1007109+00	.6090139-01	.4366657-01
34	.0000000	.0000000	.1453732-00	.9913000-01	.3316341-01
34	.0000000	.0000000	.5234500-01	.2844115-01	.2147447-01
39	.0000000	.0000000	.1132343+00	.7789290-01	.2394332+01
39	.0000000	.0000000	.5673070-01	.3316341-01	.2799188+01
EIGENVALUES	.0000000	.0000000	.2700233-00	.1101648+00	.1591112+01
BETA,RHO	.0000000	.0000000	.2764057-02	.2120568-02	.5665159+00

SQR ROOTS OF DIAG	.3190140-00	.1266906-00	.2179302-00	.2297637-00	.3001278-00	.1762417-00	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

	17	23	28	34	39
17	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.0000000	.0000000	.0000000	.0000000	.0000000
BETA,RHO	.0000000	.0000000	.0000000	.0000000	.0000000

SQR ROOTS OF DIAG	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

	17	23	28	34	39
17	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000
28	.1446899-00	.2505856-01	.8401095-01	.8042547-01	.1157415+00	.1649369-02	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

	28	34	39
28	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000

MISSION II FRAME 162 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.6285387-02	-.1575805-03	.0000000	.0000000	.6745078-02	.1638278-03	.2606374-02	-.1437744-03	.2689736-02
0	-.1575805-03	.8881442-04	.0000000	.0000000	-.1624223-03	.8524727-04	-.5537496-04	.6342351-04	-.5917315-04
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
6	.6745078-02	-.1624223-03	.0000000	.0000000	.7242809-02	.1827357-03	.2797542-02	-.1476109-03	.2885871-02
6	.1638277-03	.8524727-04	.0000000	.0000000	.1827357-03	.9837688-04	.7834699-04	.5908322-04	.7875757-04
12	.2606374-02	-.5537496-04	.0000000	.0000000	.2797542-02	.7834699-04	.1132457-02	-.4098108-04	.1162550-02
12	-.1437744-03	.6342350-04	.0000000	.0000000	-.1476109-03	.5908322-04	-.4098108-04	.4979750-04	-.4562437-04
17	.2689736-02	-.5917315-04	.0000000	.0000000	.2885871-02	.7875757-04	.1162550-02	-.4562437-04	.1194411-02
EIGENVALUES	.6289392-02	.8480973-04	.0000000	.0000000	.7247480-02	.9370601-04	.1134006-02	.4824850-04	.1202051-02
BETA,RHO	.3585442+03	-.2109088-00	.0000000	.0000000	.1464198+01	.2164828-00	.3578364+03	-.1725714-00	.3653361+03
SQR ROOTS OF DIAG	.7928043-01	.9424140-02	.0000000	.0000000	.8510469-01	.9918512-02	.3365200-01	.7056734-02	.3456025-01

	17	23	23	28	28	34	34	39	39
17	.5417528-04	-.1007218-03	.5880821-04	-.2389039-03	.7465337-04	.0000000	.0000000	.0000000	.0000000
23	-.1007218-03	.1276165-02	-.1639042-03	.2626363-02	-.1893640-03	.0000000	.0000000	.0000000	.0000000
23	.5880821-04	-.1639042-03	.6663135-04	-.3662279-03	.8387900-04	.0000000	.0000000	.0000000	.0000000
28	-.2389039-03	.2626363-02	-.3662279-03	.5556558-02	-.4175642-03	.0000000	.0000000	.0000000	.0000000
28	.7465337-04	-.1893640-03	.8387900-04	-.4175642-03	.1093864-03	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.4653559-04	.1297982-02	.4481416-04	.5588381-02	.7756302-04	.0000000	.0000000	.0000000	.0000000
BETA,RHO	-.3681354-00	.3524180+03	-.5620793-00	.3556418+03	-.5355978-00	.0000000	.0000000	.0000000	.0000000
SQR ROOTS OF DIAG	.7360386-02	.3572344-01	.8162803-02	.7454232-01	.1045879-01	.0000000	.0000000	.0000000	.0000000

17	-.2485980-03	.6546946-04	.0000000	.0000000	-.2601228-03	.5573654-04	-.8791109-04	.5099223-04	-.9364510-04
23	.2793005-02	-.6387164-04	.0000000	.0000000	.2995311-02	.7927264-04	.1199905-02	-.5134481-04	.1233945-02
23	-.3840138-03	.6859888-04	.0000000	.0000000	-.4063278-03	.5192220-04	-.1477006-03	.5311307-04	-.1549479-03
28	.5908294-02	-.1531526-03	.0000000	.0000000	.6336939-02	.1487951-03	.2448806-02	-.1404399-03	.2528121-02
28	-.4387337-03	.9272577-04	.0000000	.0000000	-.4639870-03	.7458655-04	-.1724537-03	.6788060-04	-.1800105-03
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

MISSION 11 FRAME 162 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS R

	0	0	1	1	6	6	12	12	17
0	.7795467-02	-.2340311-03	.0000000	.0000000	.6812614-02	.2141979-02	.1426538-02	-.1611078-04	.1788588-02
0	-.2340311-03	.9547444-04	.0000000	.0000000	-.1168397-03	.7538937-04	-.3152841-04	.5936421-04	-.4541843-04
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
6	.6812514-02	-.1168397-03	.0000000	.0000000	.6501813-02	.2176013-02	.1392061-02	.1679320-03	.1646422-02
6	.2141979-02	.7538938-04	.0000000	.0000000	.2176013-02	.8499674-03	.4613612-03	.1354241-03	.5346358-03
12	.1425538-02	-.3152841-04	.0000000	.0000000	.1392061-02	.4613612-03	.3284597-03	.5696106-04	.3718960-03
12	-.1611078-04	.5936421-04	.0000000	.0000000	.1679320-03	.1354241-03	.5696106-04	.8639965-04	.3654621-04
17	.1788588-02	-.4541843-04	.0000000	.0000000	.1646422-02	.5346358-03	.3718960-03	.3654621-04	.4433345-03
EIGENVALUES	.7802573-02	.8836790-04	.0000000	.0000000	.7244605-02	.1271749-03	.3382896-03	.7256971-04	.4573453-03
BETA,RHO	.3582607+03	-.2712745-00	.0000000	.0000000	.1884758+02	.9149403-00	.1269350+02	.3416657-00	.3494086+03
SQR ROOTS OF DIAG	.8829194-01	.9771102-02	.0000000	.0000000	.8043382-01	.2949521-01	.1804050-01	.9241193-02	.2105551-01

	17	23	23	28	28	34	34	39	39
17	.5663291-04	-.1130697-03	.9231744-04	-.5476244-03	.2513189-03	.0000000	.0000000	.0000000	.0000000
23	-.1130697-03	.6869232-03	-.3570844-03	.2691887-02	-.1006188-02	.0000000	.0000000	.0000000	.0000000
23	.9231744-04	-.3570844-03	.2200469-03	-.1457310-02	.5976469-03	.0000000	.0000000	.0000000	.0000000
28	-.5476244-03	.2691887-02	-.1457311-02	.1116496-01	-.4215894-02	.0000000	.0000000	.0000000	.0000000
28	.2513189-03	-.1006188-02	.5976489-03	-.4215894-02	.1686599-02	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.4262202-04	.8801027-03	.2686737-04	.1277052-01	.8303643-04	.0000000	.0000000	.0000000	.0000000
BETA,RHO	-.4728779-00	.3315870+03	-.9184577-00	.3391751+03	-.9714407-00	.0000000	.0000000	.0000000	.0000000
SQR ROOTS OF DIAG	.7525484-02	.2620922-01	.1483398-01	.1056738-00	.4106822-01	.0000000	.0000000	.0000000	.0000000

17	-.3979278-03	.6124994-04	.0000000	.0000000	-.2416061-03	-.1098456-04	-.4683784-04	.5229687-04	-.7492867-04
23	.2287060-02	-.6489325-04	.0000000	.0000000	.1999986-02	.6363379-03	.4372613-03	.9746249-05	.5423988-03
23	-.1191238-02	.8617258-04	.0000000	.0000000	-.9629508-03	.2404632-03	-.2145765-03	.3627307-04	-.2746068-03
28	.9198051-02	-.3355740-03	.0000000	.0000000	.7625327-02	.2305203-02	.1643317-02	-.1588622-03	.2040355-02

28	-.3439547-02	.2168129-03	.0000000	.0000000	-.2786611-02	-.7294296-03	-.5448678-03	.1089474-03	-.7626477-03
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

MISSION III FRAME 37 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.1345316-02	.2049684-02	.1302243-02	.2251816-02	.1326984-02	.2042817-02	.1389134-02	.2012165-02	.1382654-02
0	.2049684-02	.1537546-01	.1604752-02	.1667585-01	.1929334-02	.1531309-01	.2483392-02	.1620483-01	.2433516-02
1	.1302243-02	.1604752-02	.1297075-02	.1771888-02	.1290572-02	.1605500-02	.1311795-02	.1583236-02	.1305586-02
1	.2251816-02	.1667585-01	.1771888-02	.1809758-01	.2119460-02	.1661025-01	.2715191-02	.1648269-01	.2663037-02
6	.1326984-02	.1929334-02	.1290572-02	.2119460-02	.1310420-02	.1923407-02	.1365583-02	.1896387-02	.1358937-02
6	.2042817-02	.1531309-01	.1605500-02	.1661025-01	.1923407-02	.1525254-01	.2469040-02	.1614449-01	.2419388-02
12	.1389134-02	.2483392-02	.1311795-02	.2715191-02	.1365583-02	.2469040-02	.1466188-02	.2435481-02	.1458384-02
12	.2012165-02	.1620483-01	.1583236-02	.1648269-01	.1896387-02	.1614449-01	.2435481-02	.1604892-01	.2383885-02
17	.1382654-02	.2433516-02	.1305586-02	.2663037-02	.1358937-02	.2419388-02	.1458384-02	.2383885-02	.1451401-02
EIGENVALUES	.1566877-01	.1052007-02	.1828242-01	.1112234-02	.1561302-01	.1049940-02	.1547291-01	.1042693-02	.1572453-01
BETA,RHO	.8185627+02	.4506722-00	.8404452+02	.3657157-00	.8228756+02	.4302242-00	.8013572+02	.5184864-00	.8044866+02
SQR ROOTS OF DIAG	.3667855-01	.1239978+00	.3601493-01	.1345272-00	.3619973-01	.1235012+00	.3829083-01	.1226740+00	.3809463-01

	17	23	23	28	28	34	34	39	39
17	.1532041-01	.2339602-02	.1549670-01	.2116132-02	.1542928-01	.2048864-02	.1689159-01	.1835461-02	.1676633-01
23	.2339602-02	.1446928-02	.2361159-02	.1406568-02	.2388951-02	.1398821-02	.2678835-02	.1352514-02	.2642635-02
23	.1549670-01	.2361159-02	.1567695-01	.2129243-02	.1560920-01	.2053768-02	.1708841-01	.1837927-02	.1696021-01
28	.2116132-02	.1406568-02	.2129243-02	.1387830-02	.2155894-02	.1404069-02	.2422896-02	.1361093-02	.2393567-02
28	.1542928-01	.2388951-02	.1560920-01	.2155894-02	.1555104-01	.2078258-02	.1703650-01	.1860901-02	.1690763-01
34	.2048864-02	.1398821-02	.2053768-02	.1404069-02	.2078258-02	.1449531-02	.2337335-02	.1407671-02	.2314726-02
34	.1689159-01	.2678835-02	.1708841-01	.2422896-02	.1703650-01	.2337335-02	.1867924-01	.2096165-02	.1853690-01
39	.1835461-02	.1352514-02	.1837927-02	.1361093-02	.1860901-02	.1407671-02	.2096165-02	.1369456-02	.2075585-02
39	.1676633-01	.2642635-02	.1696021-01	.2393567-02	.1690763-01	.2314726-02	.1853690-01	.2075585-02	.1839720-01
EIGENVALUES	.1047084-02	.1605850-01	.1065376-02	.1587194-01	.1066935-02	.1899069-01	.1138085-02	.1864655-01	.1120105-02
BETA,RHO	.5093511-00	.8082063+02	.4957595-00	.8153394+02	.4640657-00	.8241013+02	.4491873-00	.8314960+02	.4135144-00
SQR ROOTS OF DIAG	.1237756+00	.3803851-01	.1252076-00	.3725359-01	.1247038+00	.3807271-01	.1366720-00	.3700616-01	.1356363-00

17	.2021316-02	.1534263-01	.1582875-02	.1663069-01	.1903907-02	.1528037-01	.2453601-02	.1616340-01	.2401686-02
23	.1380890-02	.2374033-02	.1304151-02	.2601005-02	.1356947-02	.2360141-02	.1455031-02	.2322215-02	.1448596-02
23	.2032673-02	.1551986-01	.1582396-02	.1682122-01	.1913213-02	.1545623-01	.2476133-02	.1535653-01	.2423795-02
28	.1365814-02	.2147526-02	.1316725-02	.2359885-02	.1345867-02	.2139776-02	.1414221-02	.2105579-02	.1407984-02
28	.2057057-02	.1546221-01	.1603755-02	.1674760-01	.1935583-02	.1539791-01	.2498986-02	.1628932-01	.2448804-02
34	.1385263-02	.2076878-02	.1364753-02	.2288933-02	.1368682-02	.2075938-02	.1407488-02	.2045020-02	.1400753-02
34	.2311457-02	.1693993-01	.1811174-02	.1838233-01	.2175512-02	.1687004-01	.2793849-02	.1673843-01	.2741233-02
39	.1344288-02	.1860605-02	.1330779-02	.2052019-02	.1329963-02	.1860441-02	.1360726-02	.1833521-02	.1354233-02

39	.2283707-02	.1681320-01	.1792915-02	.1824565-01	.2149462-02	.1674532-01	.2757229-02	.1661556-01	.2704842-02

MISSION III FRAME 37 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS M

	0	0	1	1	6	6	12	12	17
0	.1480113-02	.2827798-02	.9232870-03	.3674201-02	.1436378-02	.2687977-02	.2169225-02	.3056651-02	.1704306-02
0	.2827798-02	.2071507-01	-.2356670-02	.2784602-01	.1655569-02	.1995066-01	.6760643-02	.2154021-01	.4587871-02
1	.9232871-03	-.2356670-02	.1855621-02	-.3242759-02	.1241396-02	-.2206322-02	.5788065-03	-.2157254-02	.5913297-03
1	.3674200-02	.2784602-01	-.3242759-02	.3760224-01	.2058145-02	.2692199-01	.8804224-02	.2899542-01	.5933363-02
6	.1436378-02	.1655569-02	.1241395-02	.2058145-02	.1505911-02	.1565412-02	.1939828-02	.1904468-02	.1548230-02
6	.2687977-02	.1995066-01	-.2206322-02	.2692199-01	.1565412-02	.1930427-01	.6378402-02	.2083391-01	.4286736-02
12	.2169225-02	.6760643-02	.5788065-03	.8804224-02	.1939828-02	.6378402-02	.3751996-02	.7107370-02	.2826429-02
12	.3056651-02	.2154021-01	-.2157254-02	.2899542-01	.1904468-02	.2083391-01	.7107370-02	.2256423-01	.4784366-02
17	.1704306-02	.4587871-02	.5913297-03	.5933362-02	.1548230-02	.4286736-02	.2826429-02	.4784366-02	.2184285-02
EIGENVALUES	.2112218-01	.1073005-02	.3789403-01	.1563835-02	.1444091-01	.1369278-02	.2494751-01	.1368722-02	.2654703-01
BETA,RHO	.8180762+02	.5106904-00	.2751417+03	-.3882069-00	.8501172+02	.2903370-00	.7196245+02	.7724448-00	.7830388+02

SQR ROOTS OF DIAG	.3847224-01	.1439273-00	.4307692-01	.1939130-00	.3880607-01	.1389398-00	.6125354-01	.1502139-00	.4673634-01

	17	23	23	28	28	34	34	39	39
17	.2550292-01	.2075777-02	.2882814-01	.3880408-02	.2467401-01	.8809023-02	.3471897-01	.3212192-02	.3184671-01
23	.2075777-02	.1778623-02	.2182437-02	.1895377-02	.2184996-02	.2368095-02	.3617909-02	.1466673-02	.2953125-02
23	.2882814-01	.2182437-02	.3275599-01	.4099735-02	.2826306-01	.9490021-02	.3930217-01	.3237310-02	.3600273-01
28	.3880408-02	.1895377-02	.4099735-02	.2246444-02	.3822382-02	.3213118-02	.5944499-02	.1893729-02	.5185985-02
28	.2467401-01	.2184996-02	.2825306-01	.3822382-02	.2445462-01	.8472381-02	.3415349-01	.2968193-02	.3121303-01
34	.8809023-02	.2368095-02	.9490021-02	.3213118-02	.8472381-02	.5338248-02	.1258152-01	.2873829-02	.1134047-01
34	.3471897-01	.3617909-02	.3930217-01	.5944499-02	.3415349-01	.1258152-01	.4799672-01	.4682226-02	.4378685-01
39	.3212192-02	.1466673-02	.3237310-02	.1893729-02	.2968193-02	.2873829-02	.4682226-02	.1800724-02	.4173086-02
39	.3184671-01	.2953125-02	.3600273-01	.5185985-02	.3121303-01	.1134047-01	.4378685-01	.4173086-02	.4008485-01
EIGENVALUES	.1140171-02	.3290899-01	.1625621-02	.2509410-01	.1606965-02	.5143099-01	.1903985-02	.4053445-01	.1351125-02
BETA,RHO	.6757525-00	.8598976+02	.2859265-00	.8050245+02	.5157103-00	.7473242+02	.7860096-00	.8385080+02	.4911834-00

SQR ROOTS OF DIAG	.1596963-00	.4217373-01	.1809862-00	.4739667-01	.1563797-00	.7306332-01	.2190815-00	.4243494-01	.2002120-00

17	.3112200-02	.2295909-01	-.2566439-02	.3083851-01	.1854306-02	.2213100-01	.7488054-02	.2394500-01	.5043561-02
23	.1507119-02	.1958966-02	.1010561-02	.2403521-02	.1478181-02	.1732591-02	.2136474-02	.2001875-02	.1779240-02
23	.3261793-02	.2597066-01	-.3315981-02	.3481163-01	.1795148-02	.2494595-01	.8271363-02	.2695118-01	.5556132-02
28	.1806587-02	.3567098-02	.1034691-02	.4659269-02	.1709618-02	.3374282-02	.2655299-02	.3786754-02	.2109666-02

28	.3012883-02	.2245939-01	-.2726708-02	.3009099-01	.1725284-02	.2153762-01	.7368135-02	.2324954-01	.5025633-02
34	.2604337-02	.7988714-02	.9059442-03	.1071658-01	.2297454-02	.7761822-02	.4194103-02	.8542941-02	.3142896-02
34	.4683263-02	.3141226-01	-.3313090-02	.4211764-01	.2883698-02	.3013162-01	.1076736-01	.3252527-01	.7469402-02
39	.1671964-02	.2076230-02	.1138981-02	.3073267-02	.1548668-02	.2486417-02	.2176918-02	.3262667-02	.1603388-02
39	.4080297-02	.2878734-01	-.3160919-02	.3871976-01	.2423196-02	.2771146-01	.9836689-02	.2988487-01	.6533077-02

MISSION III — FRAME 39 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.2201319-03	.5364608-03	.1041725-03	.2749002-03	.2066586-03	.4457650-03	.1670547-02	.4128677-02	.0000000
0	.5364608-03	.2455118-02	.1976233-03	.1268051-02	.5220473-03	.2067275-02	.6243053-02	.1828310-01	.0000000
1	.1041725-03	.1976233-03	.5672891-04	.1064448-03	.9942179-04	.1682774-03	.5676195-03	.1234662-02	.0000000
1	.2749002-03	.1268051-02	.1064448-03	.6673100-03	.2709645-03	.1075875-02	.2982705-02	.8764558-02	.0000000
6	.2066586-03	.5220973-03	.9942178-04	.2709645-03	.1956836-03	.4371993-03	.1535721-02	.3823199-02	.0000000
6	.4457650-03	.2067275-02	.1682774-03	.1075875-02	.4371993-03	.1747703-02	.5081175-02	.1494888-01	.0000000
12	.1670547-02	.6243053-02	.5676195-03	.2982705-02	.1535721-02	.5081175-02	.2147499-01	.6028774-01	.0000000
12	.4128677-02	.1828310-01	.1234662-02	.8764558-02	.3823199-02	.1494888-01	.6028774-01	.1747834-00	.0000000
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.2577214-02	.9803593-04	.6853348-03	.3870410-04	.1862386-02	.8100014-04	.1956509-00	.6075120-03	.0000000
BETA,RHO	.7717816+02	.7297268-00	.8038900+02	.5470897-00	.7530167+02	.7475985-00	.7090764+02	.9840393-00	.0000000
									SFT MOON
SQR ROOTS OF DIAG	.1483684-01	.4954915-01	.7531860-02	.2583234-01	.1398869-01	.4180554-01	.1465435-00	.4180711-00	.0000000

	17	23	23	28	28	34	34	39	39
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.2561573-03	.6894852-03	.9752218-04	.3335024-03	.1038260-03	.3075989-03
28	.0000000	.0000000	.0000000	.6894852-03	.3673534-02	.1354021-03	.1775363-02	.1850054-03	.1659230-02
34	.0000000	.0000000	.0000000	.9752218-04	.1354021-03	.4894625-04	.7002009-04	.4979591-04	.6453315-04
34	.0000000	.0000000	.0000000	.3335024-03	.1775363-02	.7002009-04	.8773559-03	.9572411-04	.8225457-03
39	.0000000	.0000000	.0000000	.1038260-03	.1850054-03	.4979591-04	.9572411-04	.5160531-04	.8902119-04
39	.0000000	.0000000	.0000000	.3075989-03	.1659230-02	.6453315-04	.8225457-03	.8902119-04	.7720022-03
EIGENVALUES	.0000000	.0000000	.0000000	.3807400-02	.1222916-03	.9306959-04	.8823326-03	.9076778-04	.4076778-04
BETA,RHO	.0000000	.0000000	.0000000	.7901254+02	.7107707-00	.8520252+02	.3378898-00	.8305891+02	.4460021-00
		OFF MOON							
SQR ROOTS OF DIAG	.0000000	.0000000	.0000000	.1600492-01	.6060968-01	.6996160-02	.2962019-01	.7183683-02	.2778493-01

OFF MOON

17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.2364131-03	.5531365-03	.1101158-03	.2795069-03	.2200002-03	.4556839-03	.1827337-02	.4479427-02	.0000000
28	.6625942-03	.2995582-02	.2370604-03	.1533800-02	.6393288-03	.2510985-02	.7902619-02	.2304427-01	.0000000
34	.9025177-04	.1106482-03	.5069258-04	.5845421-04	.8436861-04	.9227482-04	.4226050-03	.7628364-03	.0000000
34	.3246028-03	.1460508-02	.1230760-03	.7631604-03	.3169798-03	.1233704-02	.3562399-02	.1038511-01	.0000000
39	.9711632-04	.1528878-03	.5356896-04	.8160713-04	.9170861-04	.1290423-03	.4964002-03	.1000495-02	.0000000

39	.3007887-03	.1368067-02	.1161782-03	.7171967-03	.2949611-03	.1167969-02	.3282603-02	.9602679-02	.0000000

MISSION 111 FRAME 39 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS W

	U	U	1	1	6	6	12	12	17
U	.2583232-03	.6412032-03	.6879747-04	.1353755-03	.2161661-03	.2379576-03	.0000000	.0000000	.0000000
U	.6412032-03	.2769479-02	.1687558-03	.6512955-03	.6645796-03	.1198858-02	.0000000	.0000000	.0000000
1	.6879747-04	.1687558-03	.4695623-04	.5028461-04	.9963069-04	.1089452-03	.0000000	.0000000	.0000000
1	.1353755-03	.6512955-03	.5028461-04	.1657416-03	.1698875-03	.3134333-03	.0000000	.0000000	.0000000
6	.2161661-03	.6645796-03	.9963069-04	.1698875-03	.2573420-03	.3343651-03	.0000000	.0000000	.0000000
6	.2379576-03	.1198858-02	.1089452-03	.3134333-03	.3343651-03	.4109730-03	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES BETA,RHO	.2923730-02	.1040722-03	.1841695-03	.2852840-04	.8123952-03	.6591980-04	.0000000	.0000000	.0000000
	.7647367+02	.7580799-00	.6987360+02	.5699971-00	.5893516+02	.8432467-00	.0000000	.0000000	.0000000

OFF MOON

SQR ROOTS OF DIAG	.1607243-01	.5262584-01	.6852462-02	.1287407-01	.1604168-01	.2471787-01	.0000000	.0000000	.0000000

	17	23	23	28	28	34	34	39	39
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.9700630-04	-.2278852-03	.3221341-04	-.1641970-03
34	.0000000	.0000000	.0000000	.0000000	.0000000	-.2278852-03	.8945228-03	-.2233146-04	.5719580-03
39	.0000000	.0000000	.0000000	.0000000	.0000000	.3221341-04	-.2233146-04	.2230301-04	-.1469109-04
39	.0000000	.0000000	.0000000	.0000000	.0000000	-.1641970-03	.5719580-03	-.1469109-04	.3774534-03
EIGENVALUES BETA,RHO	.0000000	.0000000	.0000000	.0000000	.0000000	.9550464-03	.3648271-04	.3780601-03	.2169634-04
	.0000000	.0000000	.0000000	.0000000	.0000000	.2848737+03	-.7736071-00	.2723647+03	-.1601182-00

OFF MOON

SQR ROOTS OF DIAG	.0000000	.0000000	.0000000	.0000000	.0000000	.9849178-02	.2990857-01	.4722607-02	.1942816-01

OFF MOON

17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	-.4116664-04	-.4184158-03	-.7008145-05	-.1062345-03	-.6425124-04	.1953428-03	.0000000	.0000000	.0000000
34	.3891585-03	.1542483-02	.8743521-04	.3553227-03	.3669687-03	.6324405-03	.0000000	.0000000	.0000000
39	.3263640-04	-.4627989-04	.1907243-04	-.1260393-04	.2826797-04	-.1916383-04	.0000000	.0000000	.0000000
39	.2395179-03	.1011143-02	.6920654-04	.2439957-03	.2555641-03	.4473682-03	.0000000	.0000000	.0000000

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MISSION III FRAME 41 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.6751403-04	.1088625-04	.4860890-04	.1460061-04	.6365939-04	.7517006-05	.8795812-04	-.5671393-06	.8997270-04
0	.1088625-04	.2974395-04	.4562941-05	.2804400-04	.9967499-05	.2810306-04	.1820024-04	.2855116-04	.1870361-04
1	.4860890-04	.4562941-05	.3674603-04	.9449876-05	.4561887-04	.2859629-05	.6073504-04	-.4871425-06	.6255985-04
1	.1460061-04	.2804400-04	.9449877-05	.3019989-04	.1297773-04	.2725696-04	.1935382-04	.2390961-04	.2069108-04
6	.6365939-04	.9967499-05	.4561887-04	.1297773-04	.6011143-04	.6669846-05	.8335999-04	-.4790336-06	.8514399-04
6	.7517006-05	.2810306-04	.2859629-05	.2725696-04	.6669846-05	.2699722-04	.1268017-04	.2687225-04	.1327380-04
12	.8795812-04	.1820024-04	.6073504-04	.1935382-04	.8335999-04	.1268017-04	.1186336-03	.5424850-05	.1205833-03
12	-.5671393-06	.2855116-04	-.4871425-06	.2390961-04	-.4790339-06	.2687225-04	.5424850-05	.3087728-04	.5098557-05
17	.8997270-04	.1870361-04	.6255985-04	.2069108-04	.8514399-04	.1327380-04	.1205833-03	.5098557-05	.1227543-03
EIGENVALUES	.7042704-04	.2683094-04	.4347362-04	.2347230-04	.6140258-04	.2565607-04	.1189677-03	.3054320-04	.1242350-03
BETA,RMO	.1498062+02	.2429305-00	.3544795+02	.2836732-00	.1095577+02	.1657220-00	.3523982+01	.8963226-01	.7303694+01
SQR ROOTS OF DIAG	.8216692-02	.5453802-02	.6061850-02	.5495443-02	.7753156-02	.5191071-02	.1089191-01	.5556733-02	.1107946-01

	17	23	23	28	28	34	34	39	39
17	.3407666-04	.1113237-04	.3642186-04	.3859367-05	.3254527-04	-.3690485-05	.2852979-04	-.3032404-05	.2696382-04
23	.1113237-04	.1282783-03	.1901080-04	.9758537-04	.2481538-04	.6966243-04	.3290755-04	.6743654-04	.2803249-04
23	.3642186-04	.1901080-04	.3939853-04	.9362782-05	.3532039-04	-.5151784-06	.3117250-04	.1368204-06	.2916750-04
28	.3859367-05	.9758537-04	.9362782-05	.7567429-04	.1543233-04	.5623997-04	.2345622-04	.5415703-04	.2015916-04
28	.3254527-04	.2481538-04	.3532039-04	.1543233-04	.3384765-04	.6424205-05	.3270829-04	.6416331-05	.3097089-04
34	-.3690485-05	.6966243-04	-.5151784-06	.5623997-04	.6424205-05	.4518123-04	.1510371-04	.4307372-04	.1339186-04
34	.2852979-04	.3290755-04	.3117250-04	.2345622-04	.3270829-04	.1510371-04	.3506319-04	.1432238-04	.3357162-04
39	-.3032404-05	.6743654-04	.1368205-06	.5415703-04	.6416331-05	.4307372-04	.1432238-04	.4114013-04	.1257844-04
39	.2696382-04	.2803249-04	.2916750-04	.2015916-04	.3097089-04	.1339186-04	.3357162-04	.1257844-04	.3238492-04
EIGENVALUES	.3261594-04	.1321738-03	.3550298-04	.8075181-04	.2877013-04	.5605066-04	.2419376-04	.5008096-04	.2344409-04
BETA,RMO	.1785733-00	.1158030+02	.2674137-00	.1021215+02	.3049251-00	.3574080+02	.3794712-00	.3540543+02	.3446059-00
SQR ROOTS OF DIAG	.5839234-02	.1132600-01	.6276825-02	.8699097-02	.5817873-02	.6721698-02	.5921418-02	.6414057-02	.5690775-02

17	.3767130-05	.3028681-04	-.2279098-05	.2518425-04	.3679032-05	.2816864-04	.1186947-04	.3226706-04	.1155290-04
23	.9239151-04	.1926579-04	.6475276-04	.2225269-04	.8720726-04	.1394457-04	.1229235-03	.4667012-05	.1263586-03
23	.9046332-05	.3251339-04	.8811488-06	.2686751-04	.8738203-05	.2986336-04	.1970771-04	.3405728-04	.1940987-04
28	.7143567-04	.1182222-04	.5164998-04	.1625133-04	.6726924-04	.8379694-05	.9263777-04	-.6544681-06	.9488661-04
28	.1441072-04	.3154262-04	.4368141-05	.2899733-04	.1340823-04	.2940659-04	.2393099-04	.3035720-04	.2435226-04
34	.5274413-04	.4799767-05	.4084155-04	.1136800-04	.4930696-04	.3289324-05	.6470999-04	-.6287281-05	.6496025-04
34	.2157313-04	.3090448-04	.1334482-04	.3190073-04	.1972249-04	.2928711-04	.3016249-04	.2446390-04	.3143008-04
39	.6086729-04	.4709233-05	.3881719-04	.1051355-04	.4763249-04	.3110728-06	.6290775-04	-.6627722-05	.6496619-04

39	.1838419-04	.2955549-04	.1156320-04	.3107659-04	.1663954-04	.2831705-04	.2522200-04	.2525978-04	.2651919-04

MISSION 111 FRAME 41 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS *

	0	0	1	1	6	6	12	12	17
0	.8573996-04	.1511279-04	.2594557-04	.1744866-04	.5677569-04	-.1578786-04	.1351253-03	-.5945622-04	.1602874-03
0	.1511279-04	.3123369-04	-.4648082-06	.2598972-04	.8618810-05	.2100709-04	.2891955-04	.1505866-04	.3877596-04
1	.2594557-04	-.4648080-06	.1066525-04	.5638255-05	.1628334-04	-.5932499-05	.3532091-04	-.2110884-04	.4345947-04
1	.1744866-04	.2598972-04	.5638255-05	.6489425-04	-.8455986-05	.3881811-04	-.1420186-04	.3262437-05	.1835154-04
6	.5677569-04	.8618810-05	.1628334-04	-.8455986-05	.4641793-04	-.2134113-04	.1094441-03	-.3739319-04	.1151500-03
6	-.1578786-04	.2100709-04	-.5932499-05	.3881811-04	-.2134113-04	.3530240-04	-.4511130-04	.3034219-04	-.3328596-04
12	.1351253-03	.2891955-04	.3532091-04	-.1420186-04	.1094441-03	-.4511130-04	.2629011-03	-.8371902-04	.2786769-03
12	-.5945622-04	.1505866-04	-.2110884-04	.3262437-05	-.3739319-04	.3034219-04	-.8371902-04	.6695655-04	-.1001091-03
17	.1602874-03	.3877596-04	.4345947-04	.1835154-04	.1151500-03	-.3328596-04	.2786769-03	-.1001091-03	.3160350-03
EIGENVALUES	.8964978-04	.2732387-04	.6547426-04	.1008524-04	.6291311-04	.1880722-04	.2937987-03	.3605897-04	.3160421-03
BETA,NMO	.1450493+02	.2920392-00	.8412659+02	.2143167-00	.3222965+03	-.5271963-00	.3397428+03	-.6310029-00	.2957310-00
SQR ROOTS OF DIAG	.9259587-02	.5568711-02	.3265769-02	.8055697-02	.6813071-02	.5941582-02	.1621423-01	.8182698-02	.1777737-01

	17	23	23	28	28	34	34	39	39
17	.5099897-04	-.1349293-04	.7011482-04	-.2664552-04	.4806408-04	-.4342853-04	.2604996-04	-.2753008-04	.1230756-04
23	-.1349293-04	.4367663-03	.1381122-03	.2600045-03	.1375500-03	.1573000-03	.1671260-03	.1107813-03	.1108826-03
23	.7011482-04	.1381122-03	.1556815-03	.5241821-04	.1205672-03	-.1345472-04	.9573197-04	-.4479698-05	.5196555-04
28	-.2664552-04	.2600045-03	.5241821-04	.1639244-03	.6263237-04	.1139889-03	.9108150-04	.7863499-04	.6636527-04
28	.4806408-04	.1375500-03	.1205672-03	.6263237-04	.9806993-04	.9736229-05	.8760633-04	.9268082-05	.5401467-04
34	-.4342853-04	.1573000-03	-.1345472-04	.1139889-03	.9736229-05	.1025854-03	.4479238-04	.6849422-04	.4458431-04
34	.2604996-04	.1671260-03	.9573197-04	.9108150-04	.8760633-04	.4479238-04	.9236140-04	.3132542-04	.6563691-04
39	-.2753008-04	.1107813-03	-.4479698-05	.7863499-04	.9268082-05	.6849422-04	.3132543-04	.4630152-04	.2949090-04
39	.1230756-04	.1108826-03	.5196555-04	.6636527-04	.5401467-04	.4458432-04	.6563691-04	.2949090-04	.5501092-04
EIGENVALUES	.5099191-04	.4932700-03	.9917782-04	.2019722-03	.6082214-04	.1425565-03	.6239026-04	.8046690-04	.2084553-04
BETA,NMO	.1077672-01	.2225016+02	.5296501-00	.3127776+02	.4919771-00	.4174460+02	.4601677-00	.4919987+02	.5843406-00
SQR ROOTS OF DIAG	.7141356-02	.2089895-01	.1247724-01	.1280330-01	.9943336-02	.1012845-01	.9610484-02	.6809522-02	.7416935-02

17	-.1179350-04	.2999071-04	-.1047929-04	.1281824-06	.1419676-05	.1701626-04	.1182541-04	.4101091-04	.1368027-05
23	.1912249-03	.4816752-04	.5178801-04	.5424672-04	.1232019-03	-.2204776-04	.2997569-03	-.1229435-03	.3619646-03
23	.5233160-04	.5825014-04	.3097887-05	.8971271-05	.5026540-04	.9373985-05	.1345972-03	.1263696-04	.1375046-03
28	.1153711-03	.2032588-04	.3602858-04	.4228059-04	.6768438-04	-.1158241-04	.1617471-03	-.8325678-04	.2062123-03

28	.6284291-04	.4932612-04	.6030662-05	.2246493-04	.4151991-04	.1233906-04	.1119540-03	.5837227-06	.1247797-03
34	.7158062-04	.2113316-05	.2805732-04	.4697565-04	.3018185-04	.4052856-07	.6764370-04	-.6347406-04	.1081514-03
34	.6630288-04	.4617593-04	.1281212-04	.4264249-04	.4040287-04	.1616812-04	.1079480-03	-.1825964-04	.1360029-03
39	.5085557-04	.1824706-06	.2000560-04	.2901315-04	.2376890-04	-.1882825-05	.6292780-04	-.4349662-04	.7904759-04
39	.4251504-04	.3380663-04	.9457266-05	.4968566-04	.1768629-04	.2434431-04	.5049290-04	-.9360627-05	.7911167-04

MISSION III FRAME 69 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.3709008-04	.4028397-05	.3015417-04	.6500177-05	.3552841-04	.2793716-05	.4442209-04	-.1051970-05	.4517904-04
0	.4028397-05	.1242254-04	.1817979-05	.1231910-04	.3602024-05	.1190085-04	.6488944-05	.1155941-04	.6658319-05
1	.3015417-04	.1817979-05	.2784250-04	.6555846-05	.2877829-04	.1934179-05	.3182400-04	-.3162848-05	.3284643-04
1	.6500177-05	.1231910-04	.6555846-05	.1500617-04	.5874286-05	.1268683-04	.5809168-05	.1008258-04	.6451200-05
6	.3552841-04	.3602024-05	.2877829-04	.5874286-05	.3405617-04	.2451493-05	.4271635-04	-.1080691-05	.4340786-04
6	.2793716-05	.1190085-04	.1934179-05	.1268683-04	.2451493-05	.1180460-04	.3598826-05	.1087415-04	.3842069-05
12	.4442209-04	.6488944-05	.3182400-04	.5809168-05	.4271635-04	.3598826-05	.5878189-04	.1608431-05	.5913531-04
12	-.1051970-05	.1155941-04	-.3162848-05	.1008258-04	-.1080691-05	.1087415-04	.1608431-05	.1190312-04	.1493364-05
17	.4517904-04	.6658319-05	.3284643-04	.6451200-05	.4340786-04	.3842069-05	.5913531-04	.1493364-05	.5957519-04
EIGENVALUES	.3773127-04	.1176134-04	.3059806-04	.1229980-04	.3432306-04	.1153771-04	.5688703-04	.1184800-04	.6002362-04
BETA,RMU	.9043913+01	.1876714-00	.2280400+02	.3207301-00	.8213087+01	.1222664+00	.1762787+01	.6080655-01	.5600388+01
SQR ROOTS OF DIAG	.6090162-02	.3524562-02	.5276599-02	.3873779-02	.5835767-02	.3435782-02	.7666936-02	.3450090-02	.7718497-02

	17	23	23	28	28	34	34	39	39
17	.1339644-04	.4331553-05	.1451771-04	.6974506-06	.1323028-04	-.3315201-05	.1182595-04	-.3018678-05	.1100237-04
23	.4331553-05	.6079085-04	.7920048-05	.4796277-04	.9570343-05	.3576614-04	.1243625-04	.3500149-04	.1006759-04
23	.1451771-04	.7920048-05	.1608841-04	.2761785-05	.1440419-04	-.2918669-05	.1257673-04	-.2540334-05	.1141110-04
28	.6974506-06	.4796277-04	.2761785-05	.4031986-04	.5652519-05	.3375722-04	.9817264-05	.3274622-04	.8601220-05
28	.1323028-04	.9570343-05	.1440419-04	.5652519-05	.1399192-04	.1652613-05	.1372142-04	.1692924-05	.1292398-04
34	-.3315201-05	.3576614-04	-.2918669-05	.3375722-04	.1652613-05	.3344031-04	.7657989-05	.3206499-04	.7728777-05
34	.1182595-04	.1243625-04	.1257673-04	.9817264-05	.1372142-04	.7657989-05	.1537049-04	.7279395-05	.1498107-04
39	-.3018678-05	.3500149-04	-.2540334-05	.3274622-04	.1692924-05	.3206499-04	.7279395-05	.3078147-04	.7268576-05
39	.1100237-04	.1006759-04	.1141110-04	.8601220-05	.1292398-04	.7728777-05	.1498107-04	.7268576-05	.1485742-04
EIGENVALUES	.1294810-04	.6215258-04	.1472667-04	.9148213-04	.1282965-04	.3624915-04	.1256165-04	.3360026-04	.1203863-04
BETA,RMU	.1618424-00	.9755770+01	.2532516-00	.1161918+02	.2379018-00	.2019231+02	.3377814-00	.2119657+02	.3398857-00
SQR ROOTS OF DIAG	.3660114-02	.7796848-02	.4011036-02	.6349792-02	.3740578-02	.5782759-02	.3920522-02	.5548105-02	.3854533-02

17	.6284796-06	.1214654-04	-.2678869-05	.1004841-04	.5592274-06	.1110695-04	.4762738-05	.1249449-04	.4572143-05
23	.4610269-04	.6851150-05	.3408674-04	.7212449-05	.4426251-04	.4183284-05	.6757678-04	.1342977-05	.6012057-04
23	.2643136-05	.1289068-04	-.2102733-05	.1004730-04	.2524568-05	.1142526-04	.8548699-05	.1324223-04	.8268151-05
28	.3865984-04	.4375621-05	.3153685-04	.7127941-05	.3700834-04	.3136633-05	.4613719-04	-.1023832-05	.4696982-04
28	.5298626-05	.1299186-04	.1726277-05	.1200066-04	.4945747-05	.1204218-04	.9477628-05	.1228567-04	.9624356-05
34	.3221704-04	.2002506-05	.3041947-04	.7798087-05	.3088430-04	.2377996-05	.3807736-04	-.3649268-05	.3429304-04
34	.9161267-05	.1329867-04	.6809442-05	.1454560-04	.8487559-05	.1293020-04	.1146396-04	.1123448-04	.1190433-04
39	.3127759-04	.1925767-06	.2924600-04	.7240365-05	.2981611-04	.2183287-05	.3260624-04	-.3421004-05	.3363414-04

39	.7952581-05	.1283840-04	.6700901-05	.1474076-04	.7306044-05	.1280476-04	.8894070-05	.1069544-04	.9431491-05

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MISSION III FRAME 69 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS W

	0	0	1	1	6	6	12	12	17
0	.4806680-04	.6354217-05	.2393891-04	.1146057-04	.3677271-04	-.6364997-05	.6724202-04	-.2478356-04	.7467361-04
0	.6354217-05	.1323024-04	.5012266-06	.1301676-04	.3749359-05	.9658777-05	.1136998-04	.6350280-05	.1413319-04
1	.2393891-04	.5012267-06	.2013519-04	.1897261-04	.1441833-04	.5555495-05	.1537697-04	-.9292948-05	.2322361-04
1	.1146057-04	.1301675-04	.1897261-04	.6503303-04	-.3927940-05	.3483513-04	-.2550218-04	.1134171-04	-.8710639-05
6	.3677271-04	.3749359-05	.1441833-04	-.3927940-05	.3024866-04	-.1254049-04	.6159108-04	-.2063424-04	.6301647-04
6	-.6364997-05	.9658777-05	.5555495-05	.3483513-04	-.1254049-04	.2726229-04	-.3542551-04	.1784521-04	-.2662175-04
12	.6724202-04	.1136998-04	.1537697-04	-.2550218-04	.6159108-04	-.3542551-04	.1416151-03	-.4273282-04	.1384834-03
12	-.2478356-04	.6350280-05	-.9292948-05	.1134171-04	-.2063424-04	.1784521-04	-.4273282-04	.2424136-04	-.4309423-04
17	.7467361-04	.1413319-04	.2322361-04	-.8710639-05	.6301647-04	-.2662175-04	.1384834-03	-.4309423-04	.1413141-03
EIGENVALUES	.4918962-04	.1210742-04	.6336055-04	.1180767-04	.4138454-04	.1612640-04	.1555246-03	.1033178-04	.1415897-03
BETA,RHO	.1002103+02	.2519739-00	.6630222+02	.5699511-00	.3183951+03	-.4366970-00	.3419699+03	-.7293374-00	.2708027+01
SQR ROOTS OF DIAG	.6933022-02	.3637340-02	.4487225-02	.7418425-02	.5499678-02	.5221330-02	.1190021-01	.4923550-02	.1188756-01

	17	23	23	28	28	34	34	39	39
17	.1840054-04	.2344037-06	.3041738-04	-.1077760-04	.2300789-04	-.2419079-04	.1455310-04	-.1733931-04	.5029125-05
23	.2344041-06	.1509215-03	.6341287-04	.1035550-03	.5214573-04	.6909764-04	.6177421-04	.5238364-04	.3859107-04
23	.3041738-04	.6341288-04	.7421474-04	.1059975-04	.5755501-04	-.3153522-04	.4175910-04	-.2201808-04	.1210325-04
28	-.1077760-04	.1035550-03	.1059975-04	.8011130-04	.1816484-04	.7405376-04	.3449946-04	.6532783-04	.3120409-04
28	.2300789-04	.5214573-04	.5755501-04	.1816484-04	.4699992-04	-.1263959-04	.3843882-04	-.8659046-05	.1695765-04
34	-.2419079-04	.6909764-04	-.3153522-04	.7405376-04	-.1263959-04	.9707218-04	.1498637-04	.7153561-04	.3230928-04
34	.1455310-04	.6177421-04	.4175910-04	.3449946-04	.3843882-04	.1498637-04	.3928686-04	.1110310-04	.2607919-04
39	-.1733931-04	.5238364-04	-.2201808-04	.6532783-04	-.8659046-05	.7153561-04	.1110310-04	.5311758-04	.2332454-04
39	.5029126-05	.3859107-04	.1210325-04	.3120409-04	.1695765-04	.3230928-04	.2607919-04	.2332454-04	.2751016-04
EIGENVALUES	.1812494-04	.1847352-03	.4840110-04	.8813309-04	.3897814-04	.1007276-03	.3563145-04	.6692156-04	.1370618-04
BETA,RHO	.1142664+00	.2579378+02	.4918237-00	.2382676+02	.2960303-00	.1370769+02	.2426752-00	.3061799+02	.6101651-00
SQR ROOTS OF DIAG	.4289565-02	.1260641-01	.8614798-02	.8950492-02	.6855649-02	.9852521-02	.6267923-02	.7288181-02	.5245013-02

17	-.5394141-05	.1163271-04	-.1001818-04	-.4357479-05	-.5903584-06	.2322770-05	.9803701-05	.1041596-04	.5826753-05
23	.8438392-04	.1669097-04	.3301476-04	.1038030-04	.6550224-04	-.1720591-04	.1361937-03	.4475076-04	.1459937-03
23	.1684639-04	.2025098-04	-.1172243-04	.2080279-04	.2239409-04	.1382575-04	.7135424-04	-.3604086-05	.6347330-04
28	.6065953-04	.8454007-05	.3369323-04	.2637888-04	.4156901-04	-.7270453-06	.7327033-04	-.2954538-04	.8664048-04

28	.1938996-04	.1901493-04	-.4777278-05	-.6461408-05	.2001065-04	-.6980515-06	.5871806-04	-.3558057-05	.5599429-04
34	.4937177-04	.2883510-05	.4201826-04	.5170262-04	.2519662-04	.1819293-04	.2264492-04	-.1934694-04	.4345617-04
34	.2827372-04	.1919485-04	.5843286-05	.1225641-04	.2155328-04	.2860161-05	.6282254-04	-.6158165-05	.5712308-04
39	.3752764-04	.2100063-05	.3183412-04	.3697778-04	.2006612-04	.1272148-04	.1908756-04	-.1436918-04	.3399645-04
39	.2096824-04	.1553976-04	.1214417-04	.3091350-04	.1030686-04	.1655630-04	.1759752-04	.8973275-06	.2744137-04

MISSION III FRAME 121 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	4	4	12	12	17
0	.6416462-01	-.6997540-03	.9367649-01	.1383057-01	.6418940-01	.2602945-02	.5496583-01	-.6398866-02	.5605653-01
0	-.6997540-03	.1136093-01	-.7761260-03	.1436128-01	-.7231596-03	.1159407-01	-.8182069-03	.1011364-01	-.6665948-03
1	.9367649-01	-.7761260-03	.1366600-00	.1997026-01	.9373626-01	.4017027-02	.8022749-01	-.7275906-02	.8175707-01
1	.1383057-01	.1436128-01	.1997026-01	.2351169-01	.1340571-01	.1556670-01	.1121463-01	.1028677-01	.1195905-01
4	.6418940-01	-.7231596-03	.9373626-01	.1340571-01	.6430740-01	.2553553-02	.5505587-01	-.5131209-02	.5609558-01
4	.2602945-02	.1159407-01	.4017027-02	.1556670-01	.2553553-02	.1202472-01	.1977024-02	.9987616-02	.2209746-02
12	.5496583-01	-.8182069-03	.8022749-01	.1121463-01	.5505587-01	.1977024-02	.4715774-01	-.4573362-02	.4804482-01
12	-.6398866-02	.1011364-01	-.7275906-02	.1028677-01	-.5131209-02	.9987616-02	-.4573362-02	.1038548-01	-.4735427-02
17	.5605653-01	-.6665948-03	.8175707-01	.1195905-01	.5609558-01	.2209746-02	.4804482-01	-.4735427-02	.4899834-01
EIGENVALUES	.6416389-01	.1134166-01	.1400813-00	.2009046-01	.6443182-01	.1190030-01	.4771801-01	.9825228-02	.4972338-01
BETA,RHO	.3592409+03	-.2593079-01	.9721327+01	.3523069-00	.2789560+01	.9182840-01	.3930159+03	-.2066549-00	.3522715+03
SQR ROOTS OF DIAG	.2532876-00	.1046407-00	.3696756-00	.1533352-00	.2535890-00	.1096573+00	.2171584-00	.1019092+00	.2213557-00

	17	23	23	28	28	34	34	39	39
17	.1035743-01	-.5558385-02	.1046870-01	-.6343911-02	.1031841-01	-.9830911-02	.1142109-01	-.9120269-02	.1066121-01
23	-.5558385-02	.5154474-01	-.6387583-02	.5770937-01	-.3133062-02	.8710783-01	-.6493769-03	.8537310-01	.5555746-02
23	.1046870-01	-.6387583-02	.1059485-01	-.7277662-02	.1038770-01	-.1124720-01	.1144515-01	-.1050578-01	.1058296-01
28	-.6343911-02	.5770937-01	-.7277662-02	.6463023-01	-.3618468-02	.9757905-01	-.8244946-03	.9562424-01	.6131658-02
28	.1031841-01	-.3133062-02	.1038770-01	-.3618468-02	.1129655-01	-.5761398-02	.1416681-01	-.5414077-02	.1368798-01
34	-.9830911-02	.8710783-01	-.1124720-01	.9757905-01	-.5761398-02	.1473624-00	-.1640436-02	.1444082-00	.8872254-02
34	.1142109-01	-.6493768-03	.1144515-01	-.8244946-03	.1416681-01	-.1640436-02	.2027285-01	-.1833509-02	.2006757-01
39	-.9120269-02	.8537310-01	-.1050578-01	.9562424-01	-.5414076-02	.1444082-00	-.1833510-02	.1416367-00	.8467483-02
39	.1066121-01	.5555746-02	.1058296-01	.6131658-02	.1368798-01	.8872256-02	.2006757-01	.8467483-02	.2061385-01
EIGENVALUES	.9632395-02	.6251798-01	.9621612-02	.6487461-01	.1105210-01	.1473035-00	.2025168-01	.1422262-00	.2002428-01
BETA,RHO	-.2371503-00	.3513368+03	-.2733361-00	.3561363+03	-.1339164-00	.3592606+03	.3001293-01	.3982895+01	.1567065-00
SQR ROOTS OF DIAG	.1017715+00	.2270347-00	.1029313+00	.2542248-00	.1062852+00	.3838781-00	.1423828-00	.3763465-00	.1435752-00

17	-.6098183-02	.1004278-01	-.8304711-02	.1004560-01	-.5833038-02	.9878342-02	-.5168688-02	.1036689-01	-.5342449-02
23	.5746805-01	-.4850124-03	.8372495-01	.1287178-01	.5743413-01	.2493253-02	.4918721-01	-.4936354-02	.5022191-01
23	-.7026673-02	.1006729-01	-.9660269-02	.9847382-02	-.6759472-02	.9853043-02	-.5957099-02	.1046710-01	-.6148820-02
28	.6436404-01	-.6462412-03	.9376385-01	.1432960-01	.6430938-01	.2694055-02	.5505900-01	-.5644286-02	.5622245-01
28	-.3631020-02	.1124872-01	-.5017104-02	.1339496-01	-.3623058-02	.1132528-01	-.3293525-02	.1036607-01	-.3218587-02
34	.9716762-01	-.1271904-02	.1415959-00	.2125510-01	.9710499-01	.3769902-02	.8311904-01	-.8771434-02	.8486988-01
34	-.1272048-02	.1443621-01	-.2068517-02	.2010911-01	-.1700567-02	.1485637-01	-.1703312-02	.1149613-01	-.1223419-02
39	.9531507-01	-.1047532-02	.1390306-00	.2062073-01	.9535311-01	.3869924-02	.8161588-01	-.8077170-02	.8326254-01

39	.5656629-02	.1427786-01	.8030649-02	.2153908-01	.6223307-02	.1505707-01	.4219772-02	.1081236-01	.4823441-02

MISSION 111 FRAME 121 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS #

	0	0	1	1	4	4	12	12	17
0	.7819488-01	-.1006404-02	.0000000	.0000000	.7017844-01	.3363682-01	.6589272-01	-.3055658-01	.7212930-01
0	-.1006404-02	.1173170-01	.0000000	.0000000	-.7313335-03	.1828539-01	-.4167164-02	.1382358-01	-.1279271-02
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
4	.7017844-01	-.7313335-03	.0000000	.0000000	.6978546-01	.3242742-01	.6337344-01	-.1981055-01	.6514533-01
4	.3363682-01	.1828539-01	.0000000	.0000000	.3242742-01	.4506174-01	.2415264-01	.1055713-01	.3047798-01
12	.6589272-01	-.4167164-02	.0000000	.0000000	.6337344-01	.2415264-01	.6929657-01	-.2498686-01	.6125293-01
12	-.3055658-01	.1382358-01	.0000000	.0000000	-.1981055-01	.1055713-01	-.2498686-01	.3551355-01	-.2822611-01
17	.7212930-01	-.1279271-02	.0000000	.0000000	.6514533-01	.3047798-01	.6125293-01	-.2822611-01	.6666302-01
EIGENVALUES	.7821009-01	.1171650-01	.0000000	.0000000	.9212739-01	.2271981-01	.7507727-01	.1973285-01	.7229035-01
BETA,RHO	.3591335+03	-.3319487-01	.0000000	.0000000	.3456617+02	.6782636-00	.3277251+03	-.5445025-00	.3423015+03
SQR ROOTS OF DIAG	.2796335-00	.1083130+00	.0000000	.0000000	.2691694-00	.2122775-00	.2435089-00	.1884504-00	.2581918-00

	17	23	23	28	28	34	34	39	39
17	.1747078-01	-.2319730-01	.2021215-01	-.2786942-01	.2309218-01	.0000000	.0000000	.0000000	.0000000
23	-.2319730-01	.1085695+00	-.1910573-01	.1151156+00	-.3543033-01	.0000000	.0000000	.0000000	.0000000
23	.2021215-01	-.1910573-01	.2424872-01	-.2458093-01	.2619258-01	.0000000	.0000000	.0000000	.0000000
28	-.2786942-01	.1151156+00	-.2458093-01	.1230260+00	-.4149770-01	.0000000	.0000000	.0000000	.0000000
28	.2309218-01	-.3543033-01	.2619258-01	-.4149770-01	.3584900-01	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.1189345-01	.1126964+00	.2012167-01	.1396207-00	.1925431-01	.0000000	.0000000	.0000000	.0000000
BETA,RHO	-.5121347-00	.3478108+03	-.3723618-00	.3382038+03	-.6248662-00	.0000000	.0000000	.0000000	.0000000
SQR ROOTS OF DIAG	.1321771-00	.3294989-00	.1557200-00	.3507607-00	.1893383-00	.0000000	.0000000	.0000000	.0000000

17	-.1902037-01	.9810502-02	.0000000	.0000000	-.1107977-01	.8792318-02	-.1505467-01	.2478259-01	-.1747764-01
23	.9069168-01	.1804830-02	.0000000	.0000000	.7730260-01	.4244274-01	.7309855-01	-.3664678-01	.8341824-01
23	-.1547632-01	.1267575-01	.0000000	.0000000	-.6425874-02	.1526300-01	-.1187187-01	.2819621-01	-.1410731-01
28	.9598846-01	-.5323632-03	.0000000	.0000000	.8023956-01	.4069165-01	.7696811-01	-.4317050-01	.8816777-01
28	-.3264756-01	.1611494-01	.0000000	.0000000	-.2634928-01	.1169730-01	-.3012471-01	.3361930-01	-.3032028-01
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

MISSION III FRAME 140 APOLLO

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.1509064-03	.3354366-03	.9230420-04	.1959776-03	.1520639-03	.3000964-03	.4219362-03	.8245148-03	.4222436-03
0	.3354366-03	.1142802-02	.1908357-03	.6741415-03	.3479665-03	.1025849-02	.1099624-02	.2764241-02	.1093044-02
1	.9230420-04	.1908357-03	.5843767-04	.1127477-03	.9329663-04	.1715975-03	.2437680-03	.4549453-03	.2423016-03
1	.1959776-03	.6741415-03	.1127477-03	.4013749-03	.2041660-03	.6066475-03	.6302099-03	.1594522-02	.6239030-03
6	.1520639-03	.3479665-03	.9329663-04	.2041660-03	.1537801-03	.3116625-03	.4251451-03	.8461913-03	.4243411-03
6	.3000964-03	.1025849-02	.1715975-03	.6066475-03	.3116625-03	.9217118-03	.9783008-03	.2466681-02	.9708657-03
12	.4219362-03	.1099624-02	.2437680-03	.6302099-03	.4251450-03	.9783008-03	.1319237-02	.2849927-02	.1329779-02
12	.8245148-03	.2764241-02	.4549453-03	.1594522-02	.8461913-03	.2466681-02	.2849927-02	.7083747-02	.2860090-02
17	.4222436-03	.1093044-02	.2423016-03	.6239030-03	.4243411-03	.9708657-03	.1329779-02	.2860090-02	.1343321-02
EIGENVALUES	.1245587-02	.4812054-04	.4351221-03	.2469045-04	.1032406-02	.4309358-04	.8254822-02	.1481620-03	.1027475-01
BETA,RHO	.7296367+02	.8077394-00	.7333671+02	.7361838-00	.7045786+02	.8283316-00	.6766157+02	.9322684-00	.7001919+02
SQR ROOTS OF DIAG	.1226440-01	.3380535-01	.7644454-02	.2003434-01	.1240113-01	.3035971-01	.3632130-01	.8416500-01	.3665134-01

	17	23	23	28	28	34	34	39	39
17	.9094032-02	.3298029-02	.1084793-01	.8969258-03	.3516492-02	.3614352-03	.1955631-02	.4287531-03	.1874895-02
23	.3298029-02	.1405996-02	.3952634-02	.4242315-03	.1244636-02	.1951137-03	.6859954-03	.2171076-03	.6551191-03
23	.1084793-01	.3952634-02	.1298513-01	.1055104-02	.4143891-02	.4189849-03	.2291959-02	.4964827-03	.2195684-02
28	.8969258-03	.4242315-03	.1055104-02	.1489297-03	.3621864-03	.7611478-04	.2058417-03	.8313991-04	.1968211-03
28	.3516492-02	.1244636-02	.4143891-02	.3621864-03	.1495176-02	.4216390-04	.8254404-03	.1794881-03	.7927315-03
34	.3614352-03	.1951137-03	.4189849-03	.7611478-04	.1495176-03	.4216390-04	.8592311-04	.4516684-04	.8219606-04
34	.1955631-02	.6859954-03	.2291959-02	.2058417-03	.8254404-03	.8592311-04	.4770018-03	.1035270-03	.4584392-03
39	.4287531-03	.2171076-03	.4964827-03	.8313991-04	.1794881-03	.4516684-04	.1035270-03	.4887395-04	.9916694-04
39	.1874895-02	.6551191-03	.2195684-02	.1968211-03	.7927315-03	.8219606-04	.4584392-03	.9916694-04	.4406942-03
EIGENVALUES	.1625991-03	.1420573-01	.1853986-03	.1539640-02	.5460452-04	.4933643-03	.2580136-04	.4443629-03	.2520525-04
BETA,RHO	.9291081-00	.7283900+02	.9250633-00	.7540257+02	.7806570-00	.7921813+02	.6058703-00	.7657606+02	.6757087-00
SQR ROOTS OF DIAG	.9536243-01	.3749661-01	.1439523+00	.1220367-01	.3801730-01	.6493373-02	.2184037-01	.6990990-02	.2099272-01

17	.9241619-03	.3102823-02	.5050479-03	.1783468-02	.9462670-03	.2765028-02	.3228886-02	.8018466-02	.3247389-02
23	.4256662-03	.1092472-02	.2420201-03	.6200716-03	.4262852-03	.9682055-03	.1354042-02	.2896378-02	.1371740-02
23	.1083428-02	.3648694-02	.5840663-03	.2086786-02	.1105883-02	.3245371-02	.3843970-02	.9640174-02	.3877140-02
28	.1495679-03	.3207914-03	.9122345-04	.1664996-03	.1500963-03	.2863990-03	.4177270-03	.7981702-03	.4192282-03
28	.3778901-03	.1284439-02	.2136883-03	.7555815-03	.3912576-03	.1151802-02	.1247480-02	.3127937-02	.1242246-02
34	.7608161-04	.1331264-03	.4866811-04	.7789653-04	.7609073-04	.1193002-03	.1941188-03	.3249161-03	.1939728-03
34	.2157606-03	.7367853-03	.1236653-03	.4373297-03	.2243047-03	.6615567-03	.6945994-03	.1746325-02	.6887466-03
39	.8361958-04	.1600586-03	.5318713-04	.9414424-04	.8408076-04	.1436763-03	.2173333-03	.3868026-03	.2165761-03

39	.2065365-03	.7069320-03	.1185892-03	.4205104-03	.2149170-03	.6368624-03	.6644718-03	.1675169-02	.6583935-03

MISSION III FRAME 140 APOLLO

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS *

	U	U	I	I	6	6	12	12	17
0	.1652186-03	.3665828-03	.9173110-04	.1016215-03	.2085758-03	.2111512-03	.0000000	.0000000	.0000000
0	.3665828-03	.1221854-02	.2189852-03	.3654479-03	.5349654-03	.7360000-03	.0000000	.0000000	.0000000
1	.9173110-04	.2189852-03	.6165121-04	.6488471-04	.1312543-03	.1378033-03	.0000000	.0000000	.0000000
1	.1016215-03	.3654479-03	.6488471-04	.1137296-03	.1568741-03	.2261217-03	.0000000	.0000000	.0000000
6	.2085758-03	.5349654-03	.1312543-03	.1568741-03	.2926840-03	.3273258-03	.0000000	.0000000	.0000000
6	.2111512-03	.7360000-03	.1378033-03	.2261217-03	.3273258-03	.4574020-03	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.1336576-02	.5099475-04	.1576017-03	.1777414-04	.7125710-03	.3751493-04	.0000000	.0000000	.0000000
BETA;RHO	.7262223+02	.8158922-00	.5593221+02	.7748976-00	.5206156+02	.8946059-00	.0000000	.0000000	.0000000
SQR ROOTS OF DIAG	.1285374-01	.3495503-01	.7851828-02	.1066417-01	.1710801-01	.2138696-01	.0000000	.0000000	.0000000

OFF MOON

	17	23	23	28	28	34	34	39	39
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.1151539-03	-.9245828-04	.5164554-04	-.2277771-04	.3499468-04	-.2458085-04
28	.0000000	.0000000	.0000000	-.9245828-04	.5778894-02	-.2535575-03	.1380672-02	.1040493-03	.1036256-02
34	.0000000	.0000000	.0000000	.5164554-04	-.2535575-03	.3453369-04	-.6810325-04	.1125099-04	-.5396271-04
34	.0000000	.0000000	.0000000	-.2277771-04	.1380672-02	-.6810325-04	.3611053-03	.3117841-04	.2743343-03
39	.0000000	.0000000	.0000000	.3499468-04	.1040493-03	.1125099-04	.3117841-04	.1822758-04	.2267379-04
39	.0000000	.0000000	.0000000	-.2458085-04	.1036256-02	-.5396271-04	.2743343-03	.2267379-04	.2100796-03
EIGENVALUES	.0000000	.0000000	.0000000	.5780403-02	.1136450-03	.3747385-04	.2090057-04	.2127229-03	.1558433-04
BETA;RHO	.0000000	.0000000	.0000000	.2709360+03	-.1133402+00	.2813200+03	-.6096590-00	.8335061+02	.3664103-00
SQR ROOTS OF DIAG	.0000000	.0000000	.0000000	.1073098-01	.7601903-01	.5876537-02	.1900277-01	.4269377-02	.1449412-01

OFF MOON

17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.6027788-04	-.5744305-04	.2117384-04	-.2842431-04	.3602803-04	-.5233848-04	.0000000	.0000000	.0000000

28	.7736523-03	.2569165-02	.4030813-03	.7438009-03	.1050344-02	.1479858-02	.0000000	.0000000	.0000000
34	-.5728129-05	-.1258711-03	-.8914121-05	-.4252767-04	-.2962628-04	-.8211103-04	.0000000	.0000000	.0000000
34	.2017701-03	.6573233-03	.1196354-03	.1980995-03	.2912334-03	.3945561-03	.0000000	.0000000	.0000000
39	.4983045-04	.5631978-04	.2624529-04	.1375365-04	.5232270-04	.3230377-04	.0000000	.0000000	.0000000
39	.1495399-03	.6018820-03	.9180816-04	.1533135-03	.2217301-03	.3056086-03	.0000000	.0000000	.0000000

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MISSION III FRAME 6 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.1613884-00	-.7799530-01	.2023072-00	.1400796-01	.1446103-00	-.1530308-00	-.1579724-00	-.9949718-00	-.2053378-00
0	-.7799528-01	.4541780-00	-.7052390-01	.1801529-00	-.3244629-01	.4330751-00	.2374302-00	.1616328-00	.2118681-00
1	.2023072-00	-.7052391-01	.2554614-00	.2973616-01	.1837432-00	-.1683163-00	-.1873957-00	-.1267952+01	-.2499409-00
1	.1400797-01	.1801529-00	.2973617-01	.8860197-01	.2890447-01	.1488045-00	.5662214-01	-.2192017-00	.3126898-01
6	.1446103-00	-.3244631-01	.1837432-00	.2890446-01	.1330023-00	-.1049508+00	-.1268054-00	-.9215248-00	-.1736689-00
6	-.1530308-00	.4330751-00	-.1683162-00	.1488045-00	-.1049508+00	.4550154-00	.2882032-00	.6710750-00	.2914771-00
12	-.1579724-00	.2374302-00	-.1873957-00	.5662215-01	-.1268053-00	.2882032-00	.2180858-00	.8448495-00	.2454192-00
12	-.9949718-00	.1616330-00	-.1267952+01	.2192016-00	-.9215248-00	.6710752-00	.8448496-00	.6411218+01	.1175590+01
17	-.2053378-00	.2118681-00	-.2499409-00	.3126900-01	-.1736689-00	.2914772-00	.2454192-00	.1175590+01	.2923699-00
EIGENVALUES	.4736588-00	.1419077-00	.2606023-00	.8346105-01	.4862008-00	.1018168+00	.6524402+01	.1049023+00	.8555105+01
BETA,RHO	.2840238+03	-.2880840-00	.9808585+01	.1976517-00	.2865490+03	-.4266220-00	.8236959+02	.7144888-00	.8767909+02
SQR ROOTS OF DIAG	.4017318-00	.6739273-00	.5054319-00	.2976608-00	.3646948-00	.6745483-00	.4669965-00	.2532038+01	.5407124-00

	17	23	23	28	28	34	34	39	39
17	.8541542+01	.7475317-00	-.2470922+01	-.4806829-00	-.1912036+01	-.6802216-00	-.9081866-00	-.7587491-00	-.8362323-00
23	.7475317-00	.7669370-01	-.8231038-00	-.8398853-01	-.1489907-00	-.1091988+00	-.8116313-01	-.1130049+00	-.6882859-01
23	-.2470920+01	-.8231038-00	.3394552+02	.2436470+01	-.5310696-00	.2918615+01	.2781534-00	.2771625+01	-.7376393-01
28	-.4806828-00	-.8398852-01	.2436470+01	.1859118-00	.3247120-01	.2265326-00	.5201188-01	.2192153-00	.2507350-01
28	-.1912036+01	-.1489907-00	.5310693-00	.3247120-01	.4749432-00	.6346799-01	.2139285-00	.8684513-01	.2087098-00
34	-.6802216-00	-.1091988+00	.2918615+01	.2265326-00	.6346798-01	.2773421-00	.7360194-01	.2696963-00	.4076125-01
34	-.9081867-00	-.8116314-01	.2781535-00	.5201138-01	.2139285-00	.7360194+00	.1072964+00	.8212471-01	.9957504-01
39	-.7587490-00	-.1130049+00	.2771625+01	.2192153-00	.8684512-01	.2696963-00	.8212471-01	.2636450-00	.5031539-01
39	-.8362324-00	-.6882861-01	-.7376378-01	.2507350-01	.2087099-00	.4076125-01	.9957505-01	.5031539-01	.9575982-01
EIGENVALUES	.2787971-00	.3396551+02	.5670190-01	.4785463-00	.1823067-00	.3047743-00	.7966427-01	.2775697-00	.8183517-01
BETA,RHO	.2119153-00	.2713913+03	-.5101331-00	.8366827+02	.1092758+00	.2044092+02	.4266666-00	.1546928+02	.3166645-00
SQR ROOTS OF DIAG	.2922590+01	.2769363-00	.5826278+01	.4311749-00	.6891612-00	.5266328-00	.3275613-00	.5134638-00	.3094508-00

17	-.6089071-00	-.1296006+01	-.8673616-00	-.7421737-00	-.6916648-00	-.7873240-00	-.3251987-01	.5047029+01	.3348857-00
23	-.8943030-01	-.6263405-01	-.1189830+00	-.5445698-01	-.8974483-01	-.6235450-02	.4618537-01	.6351492-00	.8487396-01
23	.2155930+01	-.2495110+01	.2607274+01	-.4384313-00	.1799115+01	-.3283131+01	-.2681372+01	-.1212142+02	-.3142933+01
28	.1711682-00	.1249612+00	.2117910-00	-.3549069-02	.1495043-00	-.1985830-00	-.1841956-00	-.1021261+01	-.2294348-00
28	.7171161-01	.3948963-00	.1179407+00	.1988602-00	.1028825+00	.3023242-00	.9598666-01	-.7720277-00	.2493948-01
34	.2107358-00	-.1310264-00	.2623229-00	.5642123-02	.1861574-00	-.2248363-00	-.2177565-00	-.1275192+01	-.2761359-00
34	.6566575-01	.1475214-00	.9396318-01	.8960624-01	.7450344-01	.9319313-01	.3092544-02	-.5320296-00	-.3651781-01
39	.2062234-00	-.1042458+00	.2582790-00	.1605936-01	.1843554-00	-.1994069-00	-.2036950-00	-.1266921+01	-.2636468-00
39	.4081362-01	.1651860-00	.6319291-01	.8994763-01	.5275024-01	.1216289+00	.2963750-01	-.3832127-00	-.3341651-02

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MISSION IV FRAME 6 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS W

	0	0	1	1	6	6	12	12	17
0	.2193440-00	-.1242303+00	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
0	-.1242302+00	.5227248-00	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
6	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
6	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.5671088-08	.1749609-00	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
BETA,RHO	.2896592+03	-.3669062-00	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
SQR ROOTS OF DIAG	.4683426-00	.7229971-00	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

	17	23	23	28	28	34	34	39	39
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.3353393-00	.2605778-00	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.2605778-00	.8860469-00	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.0000000	.0000000	.0000000	.9897979-00	.2315883-00	.0000000	.0000000	.0000000	.0000000
BETA,RHO	.0000000	.0000000	.0000000	.6928965+02	.4780428-00	.0000000	.0000000	.0000000	.0000000
SQR ROOTS OF DIAG	.0000000	.0000000	.0000000	.5790849-00	.9413006-00	.0000000	.0000000	.0000000	.0000000

17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.1658849-00	-.4011545-00	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

28	.4326691-00	-.1435137-00	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

MISSION IV FRAME 14 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.3385876-00	-.1636847-01	.3916137-00	.6622260-01	.3221767-00	-.1401741-01	.3638656-00	-.1439429-00	.3843278-00
0	-.1836714-01	.1169840+00	-.1694208-01	.1113126+00	-.1465668-01	.1170996+00	-.1964787-01	.1472931-00	-.2113004-01
1	.3916137-00	-.1694337-01	.4531928-00	.8062138-01	.3727979-00	-.1191386-01	.4209209-00	-.1610286-00	.4444856-00
1	.6622408-01	.1113126+00	.8062262-01	.1282101-00	.6548056-01	.1126694+00	.7086475-01	.1084824+00	.7473809-01
6	.3221767-00	-.1466799-01	.3727980-00	.6547930-01	.3067060-00	-.1064415-01	.3463640-00	-.1332150-00	.3657220-00
6	-.1401611-01	.1170997+00	-.1191262-01	.1126695+00	-.1064206-01	.1172916+00	-.1493566-01	.1467012-00	-.1621808-01
12	.3638657-00	-.1964951-01	.4209211-00	.7085318-01	.3463640-00	-.1493727-01	.3912917-00	-.1639426-00	.4131373-00
12	-.1439414-00	.1472933-00	-.1610272-00	.1084826+00	-.1332136-00	.1467013-00	-.1539407-00	.2306319-00	-.1635864-00
17	.3843279-00	-.2113168-01	.4444858-00	.7473651-01	.3657221-00	-.1621970-01	.4131373-00	-.1635882-00	.4363070-00
EIGENVALUES	.3900997-00	.1154719+00	.4720942-00	.1093087+00	.3072911-00	.1167066+00	.4846020-00	.1373216-00	.5006108-00
BETA,RHO	.3562938+03	-.9229082-01	.1319443+02	.3344652-00	.3568238+03	-.5558919-01	.3287782+03	-.5124437-00	.3349090+03
SQR ROOTS OF DIAG	.5816826-00	.3420292-00	.6731959-00	.3580644-00	.5538104-00	.3424787-00	.6255331-00	.4802415-00	.6605354-00

	17	23	23	26	28	34	34	39	39
17	.2073227-00	-.1475379-00	.1975139-00	-.1306490-00	.1464563-00	-.1603060-00	.1195469+00	-.1481169-00	.1142419+00
23	-.1475396-00	.4970704-00	-.1117373+00	.4330093-00	-.2413169-01	.5150469+00	.5176249-01	.4948956-00	.6404914-01
23	.1975137-00	-.1117354+00	.1902931-00	-.9948372-01	.1453777-00	-.1232750+00	.1238639+00	-.1124979+00	.1194323+00
28	-.1306505-00	.4330092-00	-.9948528-01	.3772631-00	-.2278114-01	.4488414-00	.4346007-01	.4311943-00	.5419349-01
28	.1464561-00	-.2412988-01	.1453777-00	-.2277975-01	.1207715+00	-.3128011-01	.1145304+00	-.2521218-01	.1125177+00
34	-.1603075-00	.5150461-00	-.1232765+00	.4488412-00	-.3128144-01	.5342016-00	.4764437-01	.5130236-00	.6047330-01
34	.1195468+00	.5176410-01	.1238639+00	.4346143-01	.1145304+00	.4764566-01	.1214521+00	.5022477-01	.1213577+00
39	-.1481184-00	.4948953-00	-.1124993+00	.4311942-00	-.2521352-01	.5130236-00	.5022348-01	.4929397-00	.6249155-01
39	.1142418+00	.6405076-01	.1194324+00	.5419482-01	.1125177+00	.6047456-01	.1213577+00	.6249281-01	.1215865+00
EIGENVALUES	.1430169-00	.5334529-00	.1539106-00	.3792707-00	.1187640+00	.5396300-00	.1160257+00	.5031749-00	.1113523+00
BETA,RHO	-.4566106-00	.3419642+03	-.3633072-00	.3549638+03	-.1067229+00	.6499954+01	.1870520-00	.9300709+01	.2552619-00
SQR ROOTS OF DIAG	.4553271-00	.7050322-00	.4362259-00	.6142175-00	.3475220-00	.7308910-00	.3484998-00	.7020966-00	.3486926-00

17	-.1208301+00	.1438036-00	-.1343850-00	.1107375+00	-.1112671+00	.1424935-00	-.1290769-00	.2181641-00	-.1373291-00
23	.4102022-00	-.2295407-01	.4743229-00	.7980925-01	.3902335-00	-.1766439-01	.4407953-00	-.1755572-00	.4656352-00
23	-.9128315-01	.1427911-00	-.1001997+00	.1170639+00	-.6313156-01	.1418550-00	-.9729289-01	.2063436-00	-.1037724+00
28	.3573435-00	-.2171119-01	.4131597-00	.6791966-01	.3398897-00	-.1709073-01	.3839264-00	-.1550770-00	.4055933-00
28	-.1931483-01	.1168534+00	-.1795660-01	.1127797+00	-.1548148-01	.1189439+00	-.2050179-01	.1500374-00	-.2218480-01
34	.4250587-00	-.2992819-01	.4913433-00	.7677974-01	.4041925-00	-.2442840-01	.4566082-00	-.1894254-00	.4824078-00
34	.9306604-01	.1129812+00	.5383936-01	.1240319+00	.9346504-01	.1140309+00	.4600729-01	.1188721+00	.4847602-01
39	.4085019-00	-.2401707-01	.4724327-00	.7819712-01	.3886317-00	-.1874873-01	.4389312-00	-.1760199-00	.4636335-00

39	.5320591-01	.1110233+00	.6552208-01	.1246418+00	.5307574-01	.1122035+00	.5688584-01	.1128514+00	.5997912-01

MISSION IV FRAME 14 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS W

	0	0	1	1	6	6	12	12	17
0	.4767012-00	-.2916004-01	.0000000	.0000000	.3454197-00	.4491351-01	.0000000	.0000000	.2114201+01
0	-.2915871-01	.1262948-00	.0000000	.0000000	.4384952-01	.2785734-00	.0000000	.0000000	-.1685457-00
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
6	.3454200-00	.4384632-01	.0000000	.0000000	.2905065-00	.1777584-00	.0000000	.0000000	.1512946+01
6	.4491548-01	.2785739-00	.0000000	.0000000	.1777604-00	.6907262-00	.0000000	.0000000	.1093216+00
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
17	.2114201+01	-.1685510-00	.0000000	.0000000	.1512945+01	.1093136+00	.0000000	.0000000	.9391334+01
EIGENVALUES	.4791112-00	.1238648+00	.0000000	.0000000	.7151397-00	.2160931-00	.0000000	.0000000	.2578994+02
BETA,RHO	.3552754+03	-.1188399+00	.0000000	.0000000	.6728490+02	.4120201-00	.0000000	.0000000	.3063219+03
			OFF MOON				OFF MOON		
SQR ROOTS OF DIAG	.6904355-00	.3553797-00	.0000000	.0000000	.5389866-00	.6004538-00	.0000000	.0000000	.3064528+01

	17	23	23	28	28	34	34	39	39
17	.1692479+02	.0000000	.0000000	-.4395232+01	.2246954-00	.0000000	.0000000	-.2331083+02	.4186453+01
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	-.4395235+01	.0000000	.0000000	.1212203+01	.1418366-00	.0000000	.0000000	.6479319+01	-.9999464-00
28	.2246836-00	.0000000	.0000000	.1418393-00	.5723986-00	.0000000	.0000000	.9057141-00	.2972595-00
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	-.2331084+02	.0000000	.0000000	.6479319+01	.9057044-00	.0000000	.0000000	.3496186+02	-.5378732+01
39	.4186448+01	.0000000	.0000000	-.9999367-00	.2972626-00	.0000000	.0000000	-.5378726+01	.1205843+01
EIGENVALUES	.5311834-00	.0000000	.0000000	.1242314+01	.5423680-00	.0000000	.0000000	.3579820+02	.3695102-00
BETA,RHO	-.9559442-00	.0000000	.0000000	.1195442+02	.1702711-00	.0000000	.0000000	.3511619+03	-.8283941-00
			OFF MOON				OFF MOON		
SQR ROOTS OF DIAG	.4113975+01	.0000000	.0000000	.1101037+01	.7565703-00	.0000000	.0000000	.5912856+01	.1098109+01

		17	23	23	28	28	34	34	39	39
17		-.2684925+01	.6281800-00	.0000000	.0000000	-.1681933+01	.7903860-00	.0000000	.0000000	-.1205196+02
23	OFF	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	MOON	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28		.7556200-00	-.7782130-01	.0000000	.0000000	.5296404-00	.1556828-02	.0000000	.0000000	.3359910+01

28	.1308466-00	.2503454-00	.0000000	.0000000	.2295018-00	.5956280-00	.0000000	.0000000	.4998746-00
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.4076675+01	-.3515669-00	.0000000	.0000000	.2909418+01	.1520496-00	.0000000	.0000000	.1611160+02
39	-.6050157-00	.2601577-00	.0000000	.0000000	-.3374277-00	.4511189-00	.0000000	.0000000	-.2755983+01

MISSION II FRAME 22 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS 1

	0	0	1	1	6	6	12	12	17
0	.6508396-00	.2305634-00	.5531267-00	.1070482+01	.5995558-00	.2998592-00	.8002519-00	-.6395503-02	.8166342-00
0	.2305675-00	.4686319-00	.1175870+00	.9936664-00	.1839834-00	.5005298-00	.2897982-00	.2922456-00	.3216790-00
1	.5531258-00	.1175830+00	.4872860-00	.7833796-00	.5157212-00	.1750531-00	.6786037-00	-.6324081-01	.6869707-00
1	.1070488+01	.9936837-00	.7833854-00	.2739600+01	.9403621-00	.1119272+01	.1326452+01	.4543311-00	.1395235+01
6	.5995556-00	.1839793-00	.5157219-00	.9403567-00	.5545379-00	.2472927-00	.7366710-00	-.2692111-01	.7497572-00
6	.2998633-00	.5005295-00	.1750571-00	.1119274+01	.2472967-00	.5399528-00	.3750963-00	.2972342-00	.4092062-00
12	.8002524-00	.2897933-00	.6786053-00	.1326446+01	.7366717-00	.3750916-00	.9841506-00	-.3333333-02	.1004755+01
12	-.6392180-02	.2922457-00	-.6321758-01	.4543335-00	-.2691780-01	.2972346-00	-.3329363-02	.2268035-00	.1596721-01
17	.8166348-00	.3216742-00	.6869724-00	.1395230+01	.7497581-00	.4092016-00	.1004755+01	.1596332-01	.1027588+01
EIGENVALUES	.6076477-00	.3118238-00	.2905273+01	.2416130-00	.7996476-00	.2998432-00	.9841653-00	.2267889-00	.1027869+01
BETA,RHO	.3421971+02	.4174854-00	.7258829+02	.6780134-00	.4415644+02	.4519301-00	.3597480+03	-.7051219-02	.1076077+01
SQR ROOTS OF DIAG	.8067463-00	.6845669-00	.6980587-00	.1655174+01	.7446730-00	.7348148-00	.9920437-00	.4762390-00	.1013700+01

	17	23	23	28	28	34	34	39	39
17	.2315205-00	.3764312-01	.2377933-00	.1251091-01	.2930285-00	-.1691250-01	.5029108-00	-.3879202-01	.4795364-00
23	.3763916-01	.1106732+01	.2743040-01	.9132240-00	.2658408-00	.9790443-00	.1260772+01	.8522057-00	.1407412+01
23	.2377934-00	.2743456-01	.2443692-00	.3502748-02	.2989511-00	-.2755938-01	.5051553-00	-.4883017-01	.4794977-00
28	.1250747-01	.9132234-00	.3499140-02	.7551863-00	.1959059-00	.8123839-00	.1001499+01	.7092910-00	.1125107+01
28	.2930286-00	.2658457-00	.2989511-00	.1959101-00	.4170484-00	.1711939-00	.8795045-00	.1182397+00	.8782619-00
34	-.1691613-01	.9790428-00	-.2756316-01	.8123831-00	.1711895-00	.8786640-00	.1008619+01	.7708461-00	.1145646+01
34	.5029097-00	.1260779+01	.5051539-00	.1001505+01	.8795029-00	.1008626+01	.2384837+01	.8264165-00	.2490558+01
39	-.3879552-01	.8522040-00	-.4883382-01	.7092901-00	.1182354+00	.7708459-00	.8264099-00	.6791384-00	.9492055-00
39	.4795365-00	.1407418+01	.4794956-00	.1125113+01	.8782594-00	.1145653+01	.2490557+01	.9492118-00	.2619990+01
EIGENVALUES	.2312395-00	.1107604+01	.2434974-00	.8448919-00	.3273428-00	.2890503+01	.3729976-00	.3007034+01	.2920948-00
BETA,RHO	.3066695-01	.1820173+01	.5274978-01	.2460287+02	.3490856-00	.6337340+02	.6967675-00	.6781663+02	.7115947-00
SQR ROOTS OF DIAG	.4811658-00	.1052013+01	.4943371-00	.8690146-00	.6457928-00	.9737708-00	.1544292+01	.8240985-00	.1618638+01

17	-.7450379-02	.2951277-00	-.6491091-01	.4579140-00	-.2816662-01	.3000580-00	-.4551427-02	.2291421-00	.1496006-01
23	.8445743-00	.3620538-00	.7042035-00	.1490113+01	.7731463-00	.4531213-00	.1039652+01	.3840765-01	.1065315+01
23	-.1638678-01	.3001193-00	-.7429409-01	.4562770-00	-.3702468-01	.3042454-00	-.1538153-01	.2353225-00	.4471413-02
28	.7001095-00	.2754188-00	.5890259-00	.1195677+01	.6427934-00	.3504629-00	.8613413-00	.1338024-01	.8809000-00
28	.1569166-00	.4386503-00	.5580605-01	.8662907-00	.1164337+00	.4626286-00	.1991869-00	.2900594-00	.2289444-00
34	.7560327-00	.2566412-00	.6451038-00	.1225394+01	.6973703-00	.3369535-00	.9293171-00	-.1565968-01	.9475388-00
34	.8856622-00	.9865943-00	.6128863-00	.2530611+01	.7653070-00	.1093528+01	.1100434+01	.4983978-00	.1168826+01
39	.6623671-00	.1927631-00	.5722168-00	.1021810+01	.6135036-00	.2625384-00	.8135832-00	-.3729292-01	.8272711-00
39	.1002734+01	.9982910-00	.7191037-00	.2674903+01	.8755582-00	.1117162+01	.1243768+01	.4755266-00	.1312959+01

MISSION IV FRAME 22 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS W

	0	0	1	1	6	6	12	12	17
0	.9098024-00	.3526348-00	.0000000	.0000000	.4268560-00	.5638810-00	.0000000	.0000000	.0000000
0	.3526389-00	.5559258-00	.0000000	.0000000	-.7588704-00	.1374877+01	.0000000	.0000000	.0000000
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
6	.4268519-00	-.7568762-00	.0000000	.0000000	.2244270+01	-.2279331+01	.0000000	.0000000	.0000000
6	.5638871-00	.1374877+01	.0000000	.0000000	-.2279323+01	.3546172+01	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.1127402+01	.3383265-00	.0000000	.0000000	.5265679+01	.5247432-00	.0000000	.0000000	.0000000
BETA,RHO	.3167722+02	.4958448-00	.0000000	.0000000	.3070306+03	-.8079588-00	.0000000	.0000000	.0000000
			OFF MOON					OFF MOON	
SQR ROOTS OF DIAG	.9538356-00	.7456043-00	.0000000	.0000000	.1498089+01	.1883128+01	.0000000	.0000000	.0000000

	17	23	23	28	28	34	34	39	39
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.2413003+01	-.5832569-00	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	-.5832492-00	.1564633+01	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.0000000	.0000000	.0000000	.2710009+01	.1267626+01	.0000000	.0000000	.0000000	.0000000
BETA,RHO	.0000000	.0000000	.0000000	.3330137+03	-.3001732-00	.0000000	.0000000	.0000000	.0000000
		OFF MOON						OFF MOON	
SQR ROOTS OF DIAG	.0000000	.0000000	.0000000	.1553384+01	.1250853+01	.0000000	.0000000	.0000000	.0000000

		17	23	23	28	28	34	34	39	39
17		.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	OFF MOON	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23		.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28		.1389242+01	.8633628-00	.0000000	.0000000	-.1150744+00	.1804826+01	.0000000	.0000000	.0000000

28	-.7251378-00	.3610831-00	.0000000	.0000000	-.1751651+01	.1325072+01	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

MISSION IV FRAME 75 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.6816138-00	.1375350-01	.1246452+01	.6544494-00	.6536690-00	.3578442-01	.1219644+01	-.6582524-00	.1226229+01
0	.1375350-01	.1083897-00	.4592272-01	.3193145-00	.1321377-01	.1966550-00	.6641402-03	.2986110-00	.2004322-01
1	.1246452+01	.4592272-01	.2285654+01	.1221493+01	.1197543+01	.8654909-01	.2220882+01	-.9753708-00	.2240747+01
1	.6544494-00	.3193145-00	.1221493+01	.1149677+01	.6233237-00	.3546534-00	.1128105+01	-.5344660-01	.1171540+01
6	.6536690-00	.1321377-01	.1197543+01	.6233237-00	.6281397-00	.3407071-01	.1170720+01	-.5300487-00	.1175907+01
6	.3578442-01	.1966550-00	.8654909-01	.3546534-00	.3407071-01	.2060541-00	.3880346-01	.2917526-00	.5956659-01
12	.1219644+01	.6641402-03	.2220882+01	.1128105+01	.1170720+01	.3880346-01	.2180977+01	-.1033977+01	.2194748+01
12	-.6582524-00	.2986110-00	-.9753708-00	-.5344660-01	-.5300487-00	.2917526-00	-.1033977+01	.1001169+01	-.1014017+01
17	.1226229+01	.2004322-01	.2240747+01	.1171540+01	.1175907+01	.5956659-01	.2194748+01	-.1014017+01	.2206602+01
EIGENVALUES	.6819971-00	.1880065-00	.3064758+01	.3705736-00	.6308722-00	.2033216-00	.2786532+01	.4020146-00	.2305970+01
BETA,RHO	.1596033+01	.3838091-01	.3253090+02	.7535254-00	.4585347+01	.9470270-01	.3299092+03	-.6986672-00	.3467320+03
SQR ROOTS OF DIAG	.8255991-00	.4340389-00	.1511836+01	.1072230+01	.7925527-00	.4539318-00	ND .1478640+01	ND .1000584+01	ND .1485463+01

	17	23	23	28	28	34	34	39	39
17	.5186477-00	-.4223868-00	.4076870-00	-.2446638-00	-.2813469-00	-.4696754-00	-.4486121-00	-.4186978-00	.2986962-00
23	-.4223868-00	.2467541+01	-.2872571-00	.1367856+01	.1385979-01	.2634194+01	.1414189-00	.2398821+01	.4901661-00
23	.4075870-00	-.2872571-00	.5006816-00	-.1482092-00	-.2479445-00	-.2579990-00	-.3940900-00	-.2707085-00	-.4493562-00
28	-.2446638-00	.1367856+01	-.1482092-00	.7586628-00	.1107053-01	.1406408+01	-.9083088-01	.1330894+01	.2600731-00
28	-.2813469-00	.1385979-01	-.2479445-00	.1107053-01	.1944700-00	.6728822-02	.2080717-00	.2034250-01	.2822992-00
34	-.4696754-00	.2634194+01	-.2579990-00	.1406408+01	.6728822-02	.2609410+01	-.1947792-00	.2469393+01	.4573177-00
34	-.4486121-00	.1414189-00	-.3940900-00	-.9083088-01	.2080717-00	-.1947792-00	.4803059-00	-.1705882-00	.4175906-00
39	-.4186978-00	.2398821+01	-.2707085-00	.1330894+01	.2034250-01	.2469393+01	-.1705882-00	.2339199+01	.4465389-00
39	.2986962-00	.4901661-00	-.4493562-00	.2600731-00	.2822992-00	.4573177-00	.4175906-00	.4465389-00	.5183655-00
EIGENVALUES	.4194749-00	.2506636+01	.4595869-00	.7568799-00	.1942529-00	.2627083+01	.4626334-00	.2442812+01	.4147529-00
BETA,RHO	-.3938412-00	.8141468+01	.2584386-00	.1123675+01	.2882159-01	.3548157+03	-.1739853-00	.1306346+02	.4055157-00
SQR ROOTS OF DIAG	ND .7203074-00	ND .1570841+01	ND .7075867-00	.8710125-00	.4409675-00	.1615367+01	.6930410-00	.1529444+01	.7199761-00

	17	23	23	28	28	34	34	39	39
17	.1224660-00	.2738072-00	.2777206-00	.2069035-00	.2146200-00	.2763642-00	.4411174-00	.2778161-00	.4214062-00
23	.1295466+01	.4206709-01	.2366731+01	.1278845+01	.1240908+01	.6612586-01	.2314831+01	.1046063+01	.2331282+01
23	.1431376-00	.2926567-00	.3030509-00	.5852396-00	.1419616-00	.3076392-00	.2232697-00	.3084449-00	.2483726-00
28	.7186849-00	.1573286-01	.1312558+01	.6965468-00	.6885969-00	.3929067-01	.1265098+01	.5920217-00	.1293287+01
28	.9574706-02	.1913447-00	.3913896-01	.3187954-00	.9482134-02	.1995050-00	.6915478-02	.3067296-00	.1237449-01
34	.1333211+01	.1538276-01	.2435455+01	.1265474+01	.1278178+01	.5829142-01	.2386068+01	-.1115522+01	.2398780+01
34	.9293209-01	.2845219-00	.1492416-00	.4037506-00	.9441035-01	.2950801-00	.2070325-00	.5193580-00	.1718717-00
39	.1262561+01	.2797709-01	.2310156+01	.1214661+01	.1211561+01	.6602413-01	.2258862+01	-.1027601+01	.2270870+01

	39
39	.2401797-00 .2809001-00 .4594130-00 .7055417-00 .2253988-00 .3017362-00 .3904093-00 .2271068-00 .4274143-00

MISSION IV FRAME 76 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS W

	0	0	1	1	6	6	12	12	17
0	.7874467-00	.1501067-01	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
0	.1501067-01	.1985659-00	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
6	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
6	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.7880290-00	.1981836-00	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
BETA,RHO	.1458721+01	.3795e15-01	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

ON MOON

SQR ROOTS OF DIAG	.8874946-00	.4456073-00	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

	17	23	23	28	28	34	34	39	39
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
BETA,RHO	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

OFF MOON

SQR ROOTS OF DIAG	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

OFF MOON

17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

MISSION II FRAME 21 ADDITIONAL –

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.3048812-00	-.1190302+01	-.4228543-01	-.4563416-00	-.1196316+00	-.2677383+01	.0000000	.0000000	.0000000
0	-.1190302+01	.7019659+01	.2927758-00	.1800899+01	.6526526-00	.9979305+01	.0000000	.0000000	.0000000
1	-.4228543-01	.2927758-00	.1393552-01	.5009306-01	.2889724-01	.3057774-00	.0000000	.0000000	.0000000
1	-.4563416-00	.1800899+01	.5009306-01	.8580430-00	.1522269-00	.4496714+01	.0000000	.0000000	.0000000
6	-.1196316+00	.6526525-00	.2889724-01	.1522269-00	.4605613-01	.9342385-00	.0000000	.0000000	.0000000
6	-.2677383+01	.9979305+01	.3057774-00	.4496714+01	.9342385-00	.2501935+02	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.7224416+01	.1001250+00	.8610054-00	.1047318-01	.2605428+02	.3112764-01	.0000000	.0000000	.0000000
BETA,RHO	.2797606+03	-.8136426-00	.8661565+02	.4581012-00	.8765887+02	.7267134-00	.0000000	.0000000	.0000000

OFF MOON

SQR ROOTS OF DIAG	.5521605-00	.2649464+01	.1180488+00	.9263061-00	.2570139-00	.5001934+01	.0000000	.0000000	.0000000

	17	23	23	28	28	34	34	39	39
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.9879597-00	-.4557816-00	.5474529-01	-.9619383-00	-.1976897-01	-.8995825-00
28	.0000000	.0000000	.0000000	-.4557816-00	.6896432-00	.4362764-01	.4376911-00	.6632544-01	.3814641-00
34	.0000000	.0000000	.0000000	.5474529-01	.4362764-01	.1690149-01	-.6401939-01	.1034614-01	-.8312085-01
34	.0000000	.0000000	.0000000	-.9619383-00	.4376911-00	-.8401939-01	.1163522+01	-.5652399-02	.1092630+01
39	.0000000	.0000000	.0000000	-.1978897-01	.6632545-01	.1034614-01	-.5652398-02	.9839817-02	-.9051335-02
39	.0000000	.0000000	.0000000	-.8995825-00	.3814641-00	-.8312085-01	.1092630+01	-.9051335-02	.1027737+01
EIGENVALUES	.0000000	.0000000	.0000000	.1318369+01	.3592339-00	.1169646+01	.1077762-01	.1027817+01	.9759329-02
BETA,RHO	.0000000	.0000000	.0000000	.3240606+03	-.5521727-00	.2741687+03	-.5991420-00	.2705094+03	-.9000739-01

OFF MOON

SQR ROOTS OF DIAG	.0000000	.0000000	.0000000	.9939616-00	.8304476-00	.1300057-00	.1078667+01	.9919585-01	.1013774+01

OFF MOON

17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.5384212-00	-.2398501+01	-.9089676-01	-.8049505-00	-.2360008-00	.4662200+01	.0000000	.0000000	.0000000
28	-.1758289-00	.1855986+01	.8367196-01	.3178912-00	.1531636-00	.1434401+01	.0000000	.0000000	.0000000
34	.4160658-01	-.1538571-01	.3732847-02	-.8003762-01	-.1739590-02	-.4486701-00	.0000000	.0000000	.0000000
34	-.5354354-00	.2250973+01	.6720553-01	.9954058-00	.1414239-00	.6213152+01	.0000000	.0000000	.0000000
39	-.1037873-02	.1454370-00	.9053509-02	-.1275450-01	.1398203-01	-.6292645-01	.0000000	.0000000	.0000000

39	-.6051331-00	.2060117+01	.6004469-01	.9378779-00	.1767366-00	.4929089+01	.0000000	.0000000	.0000000

MISSION V FRAME 21 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS

	0	0	1	1	6	6	12	12	17
0	.3133965-00	-.1238411+01	-.1861685-00	-.1902639-00	-.3306646-00	-.2199323-00	.0000000	.0000000	.0000000
0	-.1238411+01	.7001236+01	.8184765-00	.7185613-00	.1219446+01	.5575593-00	.0000000	.0000000	.0000000
1	-.1861685-00	.8184765-00	.1143091+00	.1153441+00	.1948042-00	.1253703-00	.0000000	.0000000	.0000000
1	-.1902639-00	.7185614-00	.1153441+00	.3650983-00	.3124212-00	.6166989-00	.0000000	.0000000	.0000000
6	-.3306646-00	.1219446+01	.1948042-00	.3124212-00	.4014346-00	.4567362-00	.0000000	.0000000	.0000000
6	-.2199323-00	.5575593-00	.1253703-00	.6166989-00	.4567362-00	.1118759+01	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.7223191+01	.9144372-01	.4100799-00	.6932746-01	.1340828+01	.1793660-00	.0000000	.0000000	.0000000
BETA,KMO	.2801610+03	-.8360437-00	.6869531+02	.5646120-00	.6407072+02	.6815404-00	.0000000	.0000000	.0000000
SQR ROOTS OF DIAG	.5598201-00	.2645985+01	.3380963-00	.6042336-00	.6335686-00	.1057714+01	.0000000	.0000000	.0000000

OFF MOON

	17	23	23	26	28	34	34	39	39
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
26	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.1910196-01	-.6452748-01
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	-.6452748-01	.4814603-00
EIGENVALUES	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.4902969-00	.1026480-01
BETA,KMO	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.2777978+03	-.6728700-00
SQR ROOTS OF DIAG	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.1382080-00	.6938734-00

OFF MOON

17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.2878146-01	.2995793-01	-.1168263-01	-.5956359-01	-.5378057-01	-.1179076+00	.0000000	.0000000	.0000000
39	-.2710719-00	.1073804+01	.1645485-00	.4125050-00	.3956250-00	.6660211-00	.0000000	.0000000	.0000000

MISSION V FRAME 22 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.2280618-01	-.7341474-01	.4091809-01	-.7687808-01	.1611167-01	-.6131089-01	.2297089-01	-.1260310-00	.4135706-01
0	-.7341474-01	.9195274-00	-.1865087-00	.8537867-00	-.5093815-02	.7427304-00	.5471173-02	.1901880+01	-.3304064-00
1	.4091809-01	-.1865087-00	.9437126-01	-.2257353-00	.3123111-01	-.1572475-00	.4407498-01	-.2372691-00	.6241496-01
1	-.7687808-01	.8537867-00	-.2257353-00	.8937347-00	-.2688530-01	.7024264-00	-.2869622-01	.1504343+01	-.2505165-00
6	.1611167-01	-.5093815-02	.3123111-01	-.2688530-01	.1688648-01	-.6823862-02	.2522879-01	.5541538-01	.5271033-02
6	-.6131089-01	.7427304-00	-.1572475-00	.7024264-00	-.6823862-02	.6046388-00	.3438371-03	.1522480+01	-.2647311-00
12	.2297089-01	.5471173-02	.4407498-01	-.2869622-01	.2522879-01	.3438368-03	.3806801-01	.1123841+00	.2621863-02
12	-.1260310-00	.1901880+01	-.2372691-00	.1504343+01	.5541539-01	.1522480+01	.1123841+00	.9739602+01	-.8497875-00
17	.4135706-01	-.3304064-00	.6241497-01	-.2505165-00	.5271035-02	-.2647311-00	.2621864-02	-.8497875-00	.1792935-00
EIGENVALUES	.9195378-00	.1679577-01	.9530757-00	.3503023-01	.6047180-00	.1680927-01	.4742287+01	.3538316-01	.1412963+02
BETA,RMO	.2746803+03	-.5086233-00	.2847286+03	-.7772760-00	.2706651+03	-.6752647-01	.8863146+02	.2645780-00	.2757911+03

SUM ROOTS OF DIAG .1510171-00 .9557663-00 .3071991-00 .9453754-00 .1299557-00 .7775652-00 .1951102-00 .2177063+01 .4234306-00

	17	23	23	28	28	34	34	39	39
17	.1396614+02	.0000000	.0000000	-.8063929-00	.4671098+01	.0000000	.0000000	-.2880183+01	.5941116+01
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	-.8063929-00	.0000000	.0000000	.8351180-01	-.3430244-00	.0000000	.0000000	.3013483-00	-.5351674-00
28	.4671098+01	.0000000	.0000000	-.3430244-00	.1972330+01	.0000000	.0000000	-.1450576+01	.2944602+01
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	-.2880183+01	.0000000	.0000000	.3013483-00	-.1450576+01	.0000000	.0000000	.1269660+01	-.2404799+01
39	.5941116+01	.0000000	.0000000	-.5351674-00	.2944602+01	.0000000	.0000000	-.2404800+01	.4780208+01
EIGENVALUES	.3560135-01	.0000000	.0000000	.2032697+01	.2314517-01	.0000000	.0000000	.6002189+01	.4767889-01
BETA,RMO	-.8934602-00	.0000000	.0000000	.2799809+03	-.8452035-00	.0000000	.0000000	.2969371+03	-.9761393-00

OFF MOON OFF MOON

SUM ROOTS OF DIAG .3739805+01 .0000000 .0000000 .2889841-00 .1404397+01 .0000000 .0000000 .1126792+01 .2186369+01

		17	23	23	28	28	34	34	39	39
17		-.1633528-00	.3137606+01	-.2932779-00	.2387640+01	.1439060-00	.2501468+01	.2646870-00	.8095737+01	-.1414837+01
23	OFF MOON	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23		.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28		.3716192-01	-.2398655-00	.6860414-01	-.2109229-00	.1553469-01	-.1912796-00	.1963689-01	-.5094072-00	.1134709-00
28		-.1045692-00	.1341629+01	-.2655242-00	.1244243+01	-.3153714-02	.1089956+01	.1462947-01	.2822210+01	-.4883123-00
34		.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34		.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39		.1307559-00	-.9972700-00	.3032539-00	-.1008136+01	.6066616-01	-.8197796-00	.7628637-01	-.1850300+01	.3681857-00

39		-.2029421-00	.2018676+01	-.5345405-00	.2049447+01	-.7116753-01	.1656715+01	-.7820699-01	.3733246+01	-.6629879-00

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MISSION V FRAME 22 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS R

	0	0	1	1	6	6	12	12	17
0	.2210590-01	-.7497663-01	.0000000	.0000000	-.6546023-02	-.6758668-01	.0000000	.0000000	.0000000
0	-.7497663-01	.9319697-00	.0000000	.0000000	.3147223-00	.7346373-00	.0000000	.0000000	.0000000
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
6	-.6546024-02	.3147223-00	.0000000	.0000000	.2404954-00	.1839173-00	.0000000	.0000000	.0000000
6	-.6758668-01	.7346373-00	.0000000	.0000000	.1839173-00	.6104067-00	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
12	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.9381067-00	.1596890-01	.0000000	.0000000	.6862847-00	.1646174-00	.0000000	.0000000	.0000000
BETA,RMO	.2746794+03	-.5223613-00	.0000000	.0000000	.6758064+02	.4800203-00	.0000000	.0000000	.0000000
			OFF MOON					OFF MOON	
SQR ROOTS OF DIAG	.1486805-00	.9653858-00	.0000000	.0000000	.4904033-00	.7812853-00	.0000000	.0000000	.0000000

	17	23	23	28	28	34	34	39	39
17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
BETA,RMO	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
				OFF MOON					
SQR ROOTS OF DIAG	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

OFF MOON

17	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

28	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

MISSION V FRAME 32 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.1797990-02	-.1928990-02	.1928693-02	-.1493778-02	.1680157-02	-.1667975-02	.1603692-02	-.2023820-02	.1685108-02
0	-.1928990-02	.6694366-01	-.9232962-02	.6799654-01	-.3536525-02	.6048945-01	-.3298238-02	.5892393-01	.5837674-02
1	.1928693-02	-.9232962-02	.3579100-02	-.1117635-01	.2375020-02	-.8428034-02	.1675597-02	-.6436364-02	.1191192-02
1	-.1493778-02	.6799654-01	-.1117635-01	.7637911-01	-.4386323-02	.6197713-01	-.2115100-02	.5336623-01	.5637253-02
6	.1680157-02	-.3536525-02	.2375020-02	-.4386323-02	.1822326-02	-.3214510-02	.1648256-02	-.2325492-02	.1501523-02
6	-.1667975-02	.6048944-01	-.8428034-02	.6197713-01	-.3214510-02	.5469870-01	.2928444-02	.5277072-01	.5294362-02
12	.1603692-02	.3298238-02	.1675598-02	.2115100-02	.1648256-02	.2928444-02	.2230765-02	.4083143-02	.2295323-02
12	-.2023820-02	.5892393-01	-.6436364-02	.5336623-01	-.2325492-02	.5277072-01	.4083143-02	.5762082-01	.5487100-02
17	.1685108-02	.5837674-02	.1191192-02	.5637253-02	.1501523-02	.5294362-02	.2295323-02	.5487100-02	.2583067-02
EIGENVALUES	.6700073-01	.1740921-02	.7805627-01	.1901931-02	.5489341-01	.1627624-02	.5792020-01	.1931390-02	.7099565-01
BETA,RHO	.2716946+03	-.1758254-00	.2785344+03	-.6759675-00	.2734662+03	-.3219683-00	.8580658+02	.3601454-00	.8490770+02
SQR ROOTS OF DIAG	.4240271-01	.2587347-00	.5982558-01	.2763677-00	.4268871-01	.2338775-00	.4723097-01	.2400434-00	.5082386-01

	17	23	23	28	28	34	34	39	39
17	.7045237-01	.9246472-02	.8238334-01	-.1153316-02	.7508128-01	-.1050343-01	.7983699-01	-.8945220-02	.6840193-01
23	.9246472-02	.4033783-02	.1092029-01	.2409819-02	.1146800-01	.9556818-03	.1450646-01	.7059461-03	.1268072-01
23	.8238334-01	.1092029-01	.9634616-01	-.1251770-02	.8805350-01	-.1225221-01	.9401163-01	-.1047805-01	.8056134-01
28	-.1153316-02	.2409819-02	-.1251770-02	.2357263-02	.2947268-03	.2304296-02	.2499931-02	.1855702-02	.2377446-02
28	.7508128-01	.1146800-01	.8805350-01	.2947268-03	.8688565-01	-.1143821-01	.1025997+00	-.1097922-01	.8825087-01
34	-.1050343-01	.9556818-03	-.1225221-01	.2304296-02	-.1143821-01	.3985115-02	-.1261080-01	.3623257-02	-.1063798-01
34	.7983699-01	.1450646-01	.9401163-01	.2499931-02	.1025997+00	-.1261080-01	.1351315-00	-.1390215-01	.1166540+00
39	-.8945220-02	.7059461-03	-.1047805-01	.1855703-02	-.1097922-01	.3623257-02	-.1390215-01	.3518518-02	-.1181780-01
39	.6840193-01	.1268072-01	.8056134-01	.2377446-02	.8825087-01	-.1063798-01	.1166540+00	-.1181781-01	.1007290+00
EIGENVALUES	.2039804-02	.9762041-01	.2759532-02	.8688668-01	.2356236-02	.1363331-00	.2783494-02	.1021450+00	.2102464-02
BETA,RHO	.4519153-00	.8334446+02	.5539376-00	.8980023+02	.2059404-01	.2754430+03	-.5434303-00	.2766328+03	-.6277398-00
SQR ROOTS OF DIAG	.2654267-00	.6351207-01	.3103968-00	.4855166-01	.2947637-00	.6312777-01	.3676024-00	.5931710-01	.3173783-00

17	-.2215973-02	.6532654-01	-.7170177-02	.5935407-01	-.2584340-02	.5851729-01	.4514432-02	.6371195-01	.6096390-02
23	.1774343-02	.1016135-01	.4558632-03	.1119634-01	.1281709-02	.9306592-02	.2463240-02	.8306258-02	.3071590-02
23	-.2551456-02	.7663617-01	-.8453825-02	.6991157-01	-.3033932-02	.6866945-01	.5284175-02	.7449436-01	.7178032-02
28	.1912862-02	.4497936-03	.1376912-02	.2244103-02	.1505040-02	.5803120-03	.1602792-02	-.1097521-02	.1950470-02
28	-.2281345-02	.7623329-01	-.1038012-01	.7670740-01	-.3985587-02	.6882646-01	.3841995-02	.6774018-01	.6638313-02
34	.2359897-02	-.9913366-02	.3224405-02	-.9062308-02	.2327615-02	-.8831617-02	.1410965-02	-.9510783-02	.1275511-02
34	-.2378858-02	.9089080-01	-.1517940-01	.1015490+00	-.6135301-02	.8279323-01	.2571266-02	.7179730-01	.7189779-02
39	.2151484-02	-.9629782-02	.3398042-02	-.1012114-01	.2350183-02	-.8676834-02	.1533092-02	-.8072670-02	.1228302-02

39	-.1886530-02	.7821148-01	-.1299077-01	.8770429-01	-.5180790-02	.7127150-01	.2299436-02	.6150516-01	.6322813-02

MISSION V FRAME 32 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS W

	0	0	1	1	6	6	12	12	17
0	.1665163-02	-.1979265-02	.2212591-02	-.1043728-02	.1536696-02	-.1102508-02	.2169944-02	-.1167433-02	.2229896-02
0	-.1979265-02	.6833777-01	-.1066016-01	.5899768-01	-.7221793-02	.4545907-01	-.6681284-02	.4455683-01	.2445404-01
1	.2212591-02	-.1066016-01	.3336719-01	-.2857789-01	.1953760-01	-.6466538-02	.2670634-01	.1765948-01	.1617526-01
1	-.1043728-02	.5899768-01	-.2857789-01	.6536213-01	-.1732352-01	.3853960-01	-.1971483-01	.2172108-01	.1070458-01
6	.1536695-02	-.7221793-02	.1953760-01	-.1732352-01	.1152287-01	-.3895076-02	.1519707-01	.9396628-02	.9377348-02
6	-.1102508-02	.4545908-01	-.6466538-02	.3853960-01	-.3895076-02	.3037898-01	-.2546640-02	.3076075-01	.1729575-01
12	.2169944-02	-.6681284-02	.2670634-01	-.1971483-01	.1519707-01	-.2546640-02	.2044901-01	.1521818-01	.1459490-01
12	-.1167433-02	.4455683-01	.1765948-01	.2172108-01	.9396628-02	.3076075-01	.1521818-01	.4939018-01	.2992723-01
17	.2229896-02	.2445404-01	.1617526-01	.1070458-01	.9377348-02	.1729575-01	.1459490-01	.2992723-01	.2369088-01
EIGENVALUES	.6839647-01	.1606477-02	.8211545-01	.1661386-01	.3115190-01	.1074996-01	.5591938-01	.1391961-01	.1648484-00
BETA,RHO	.2716989+03	-.1865422-00	.3003803+03	-.6119377-00	.2812247+03	-.2081848-00	.6677877+02	.4788575-00	.6952373+02

SQR ROOTS OF DIAG .4060665-01 .2614149-00 .1826669-00 .2556602-00 .1073946+00 .1742957-00 .1430000-00 .2222390-00 .1539184-00

	17	23	23	26	26	34	34	39	39
17	.1451658-00	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	-.2103275-01	.8287521-01
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
26	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
26	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	-.2103275-01	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.3820490-01	-.1607623-00
39	.8287522-01	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	-.1607623-00	.7833560-00
EIGENVALUES	.4008263-02	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.8165600-00	.5000882-02
BETA,RHO	.8986153-00	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.2816698+03	-.9292768-00

OFF MOON

SQR ROOTS OF DIAG .3810063-00 .0000000 .0000000 .0000000 .0000000 .0000000 .0000000 .1954607-00 .8850740-00

17		-.1239416-02	.7717560-01	.3016665-01	.3866646-01	.1621167-01	.5324596-01	.2651917-01	.8451471-01	.5271003-01
23	OFF	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
23	MOON	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
26		.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
26		.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34		.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34		.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39		.4617096-02	-.3929900-01	.2655727-01	-.4279174-01	.1671773-01	-.2491260-01	.1906276-01	-.1266736-01	.7435173-03
39		-.8929442-02	.1856914-00	-.1224942+00	.2202636-00	-.7366746-01	.1190702+00	-.6799980-01	.4660196-01	.9594124-02

MISSION V FRAME 38 APOLLO

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.3394622-03	-.1110804-02	.9040157-03	-.6251635-02	.3994059-03	-.1208567-02	.2864770-03	-.5609636-03	.2686987-03
0	-.1110804-02	.3619923-01	-.1297489-01	.1957352-00	-.2799132-02	.3908674-01	-.1439735-02	.1854532-01	-.8305290-03
1	.9040157-03	-.1297489-01	.5543149-02	-.7080589-01	.1523186-02	-.1402301-01	.9010864-03	-.6622640-02	.6860019-03
1	-.6251635-02	.1957352-00	-.7080589-01	.1064272+01	-.1536403-01	.2114300-00	-.7979217-02	.1000557+00	-.4719634-02
6	.3994059-03	-.2799132-02	.1523186-02	-.1536403-01	.5384620-03	-.3031400-02	.3595372-03	-.1426548-02	.3132393-03
6	-.1208567-02	.3908674-01	-.1402301-01	.2114300-00	-.3031400-02	.4220770-01	-.1564080-02	.2002272-01	-.9066423-03
12	.2864770-03	-.1439735-02	.9010864-03	-.7979217-02	.3595372-03	-.1564080-02	.2556131-03	-.7321215-03	.2319713-03
12	-.5609636-03	.1854532-01	-.6622640-02	.1000557+00	-.1426548-02	.2002272-01	-.7321215-03	.9510120-02	-.4186633-03
17	.2686987-03	-.8305290-03	.6860019-03	-.4719634-02	.3132393-03	-.9066423-03	.2319713-03	-.4186633-03	.2187910-03
EIGENVALUES	(.3623361-01	.3050869-03)	.1068986+01	.8287728-03	(.4242708-01	.3190853-03)	.9567680-02	.1780531-03	(.9575899-02
BETA,RHO	(.2717725+03	-.3168779-00)	.2738092+03	-.9218596-00	(.2741392+03	-.6358721-00)	.2744964+03	-.4695681-00	(.2725608+03

SQR ROOTS OF DIAG	.1842450-01 .1902610-00 .7445233-01 .1031636+01 .2320478-01 .2054451-00 .1598790-01 .9751984-01 .1479158-01

	17	23	23	28	28	34	34	39	39
17	.9557183-02	-.3973657-04	.9593609-02	.1731398-03	.1732313-01	.2448217-02	.1104019+00	-.1886602-02	.1047115+00
23	-.3973657-04	.2037857-03	-.3832945-04	.2408166-03	-.8142987-04	.3666111-03	-.7473623-03	.3923397-03	-.7618639-03
23	.9593609-02	-.3832945-04	.9630733-02	.1742335-03	.1738979-01	.2454544-02	.1108212+00	-.1896625-02	.1051048+00
28	.1731398-03	.2408166-03	.1742335-03	.2972145-03	.3045919-03	.5262203-03	.1736025-02	.4531621-03	.1588861-02
28	.1732313-01	-.8142986-04	.1738979-01	.3045919-03	.3142330-01	.4440401-02	.2006944-00	-.3438577-02	.1903343-00
34	.2448217-02	.3666111-03	.2454544-02	.5262203-03	.4440401-02	.1491254-02	.2837646-01	.3681224-03	.2682909-01
34	.1104019+00	-.7473623-03	.1108212+00	.1736025-02	.2006944-00	.2837646-01	.1290244+01	-.2225768-01	.1223491+01
39	-.1886602-02	.3923397-03	-.1896625-02	.4531621-03	-.3438577-02	.3681224-03	-.2225768-01	.1232237-02	-.2118561-01
39	.1047115+00	-.7618639-03	.1051048+00	.1588861-02	.1903343-00	.2682909-01	.1223491+01	-.2118561-01	.1160244+01
EIGENVALUES	.2000747-03	.9630889-02	.2036298-03	(.3142628-01	.2942341-03)	.1290869+01	.8667484-03	(.1160631+01	.8451194-03)
BETA,RHO	-.2894018-00	.2702330+03	-.2736000-01	(.8943939+02	.9966839-01)	.8873925+02	.6469139-00	(.2710468+03	-.5602982-00)

SQR ROOTS OF DIAG	.9776085-01 .1427535-01 .9813630-01 .1723991-01 .1772642-00 .3861675-01 .1135889+01 .3510323-01 .1077196+01

17	-.5621969-03	.1859121-01	-.6641062-02	.1002960+00	-.1430010-02	.2007132-01	-.7327167-03	.9533432-02	-.4184859-03
23	.2481746-03	-.9627294-04	.4281509-03	-.7919891-03	.2583637-03	-.1143700-03	.2042578-03	-.4088181-04	.2036864-03
23	-.5640738-03	.1866170-01	-.6668594-02	.1006677+00	-.1435279-02	.2014629-01	-.7339715-03	.9569306-02	-.4185540-03
28	.2899388-03	.3190207-03	.3817925-03	.1454523-02	.2828694-03	.3348482-03	.2257418-03	.1724056-03	.2321713-03
28	-.1027936-02	.3372562-01	-.1207880-01	.1822934-00	-.2601059-02	.3641315-01	-.1333828-02	.1727956-01	-.7659595-03
34	.3503022-03	.4761569-02	-.8497566-03	.2560173-01	.1440713-03	.5134671-02	.1878923-03	.2444716-02	.2683222-03
34	-.6745799-02	.2154737-00	-.7777120-01	.1171698+01	-.1677330-01	.2327301-00	-.8656509-02	.1101290+00	-.5070108-02
39	.6101423-03	-.3697577-02	.2193056-02	-.2038046-01	.7974439-03	-.4001853-02	.5243613-03	-.1879483-02	.4638898-03

39	-.6456185-02	.2043587-00	-.7383305-01	.1111187+01	-.1596816-01	.2207337-00	-.8264601-02	.1044563+00	-.4862234-02

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MISSION V FRAME 38 APOLLO

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS B

	0	0	1	1	6	6	12	12	17
0	.3558140-03	-.1222560-02	.0000000	.0000000	.9113221-03	-.1550994-02	.3211856-03	-.3725085-03	.2399815-03
0	-.1222560-02	.3889410-01	.0000000	.0000000	-.1658923-01	.4706706-01	-.3462134-02	.1250875-01	-.9964649-03
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
1	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
6	.9113221-03	-.1658923-01	.0000000	.0000000	.7572595-02	-.2020352-01	.1751687-02	-.5321617-02	.6863508-03
6	-.1550994-02	.4706706-01	.0000000	.0000000	-.2020353-01	.5712566-01	-.4271729-02	.1514089-01	-.1285375-02
12	.3211856-03	-.3462134-02	.0000000	.0000000	.1751687-02	-.4271729-02	.4812490-03	-.1114754-02	.2459232-03
12	-.3725085-03	.1250875-01	.0000000	.0000000	-.5321617-02	.1514089-01	-.1114754-02	.4034011-02	-.3144781-03
17	.2399815-03	-.9964649-03	.0000000	.0000000	.6863508-03	-.1285375-02	.2459232-03	-.3144781-03	.1798233-03
EIGENVALUES	.3893284-01	.3170692-03	.0000000	.0000000	.6431878-01	.3794706-03	.4354821-02	.1604399-03	.4032746-02
BETA,RHO	.2718152+03	-.3284373-00	.0000000	.0000000	.2895974+03	-.9713800-00	.2860550+03	-.8000657-00	.2746485+03
SQR ROOTS OF DIAG	.1886303-01	.1972159-00	.0000000	.0000000	.8702066-01	.2390097-00	.2193739-01	.6351387-01	.1340982-01

	17	23	23	28	28	34	34	39	39
17	.4007273-02	.6207727-03	.4076269-02	.3214984-02	.1158307-01	.0000000	.0000000	.0000000	.0000000
23	.6207727-03	.3080530-03	.6370066-03	.7736266-03	.1828509-02	.0000000	.0000000	.0000000	.0000000
23	.4076269-02	.6370066-03	.4158489-02	.3265488-02	.1181192-01	.0000000	.0000000	.0000000	.0000000
28	.3214984-02	.7736266-03	.3265488-02	.2986949-02	.9349378-02	.0000000	.0000000	.0000000	.0000000
28	.1158307-01	.1828509-02	.1181192-01	.9349378-02	.3360422-01	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
EIGENVALUES	.1543508-03	.4261137-02	.2054046-03	.3623340-01	.3577704-03	.0000000	.0000000	.0000000	.0000000
BETA,RHO	-.3690489-00	.8084595+02	.5628122-00	.7429326+02	.9331939-00	.0000000	.0000000	.0000000	.0000000
SQR ROOTS OF DIAG	.6330303-01	.1755144-01	.6448634-01	.5465299-01	.1833145-00	.0000000	.0000000	.0000000	.0000000

17	-.3845384-03	.1247817-01	.0000000	.0000000	-.5316589-02	.1509520-01	-.1110879-02	.4016840-02	-.3132791-03
23	.1754511-03	.1888807-02	.0000000	.0000000	-.6151265-03	.2177681-02	-.4278581-05	.6191591-03	.1261784-03
23	-.4052818-03	.1269191-01	.0000000	.0000000	-.5414819-02	.1531662-01	-.1127018-02	.4076456-02	-.3167206-03
28	.4576564-04	.9979611-02	.0000000	.0000000	-.3806610-02	.1194872-01	-.6470169-03	.3228620-02	-.1176847-04
28	-.1088767-02	.3609673-01	.0000000	.0000000	-.1530603-01	.4355046-01	-.3151510-02	.1158790-01	-.8678405-03
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
34	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000
39	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	.0000000

MISSION II FRAME 63 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.1649590-03	-.5889175-04	.1835164-03	-.3637317-04	.1681187-03	-.4971625-04	.1458977-03	-.7425320-04	.1492860-03
0	-.5889175-04	.1781706-03	-.6655871-04	.1278604-03	-.5164187-04	.1665927-03	-.3050778-04	.2398899-03	-.4108364-04
1	.1835164-03	-.6655871-04	.2043133-03	-.4387891-04	.1834446-03	-.5493973-04	.1532454-03	-.8077659-04	.1566519-03
1	-.3837317-04	.1278804-03	-.4387891-04	.9342983-04	-.3357269-04	.1198691-03	-.1903583-04	.1711976-03	-.2623301-04
6	.1681187-03	-.5164187-04	.1834446-03	-.3357269-04	.1678706-03	-.4265644-04	.1453753-03	-.6355405-04	.1481564-03
6	-.4971625-04	.1665927-03	-.5493973-04	.1198691-03	-.4265644-04	.1564641-03	-.2533785-04	.2253861-03	-.3529638-04
12	.1458978-03	-.3050778-04	.1532454-03	-.1903583-04	.1453753-03	-.2533785-04	.1340934-03	-.3925660-04	.1359891-03
12	-.7425320-04	.2398899-03	-.8077659-04	.1711976-03	-.6355406-04	.2253861-03	-.3925660-04	.3260804-03	-.5401475-04
17	.1492860-03	-.4108364-04	.1566519-03	-.2623301-04	.1481564-03	-.3529638-04	.1359891-03	-.5401475-04	.1386393-03
EIGENVALUES	.2326364-03	.1144932-03	.2195762-03	.7816693-04	.2052120-03	.1191426-03	.1337972-03	.1263766-03	.1362534-03
BETA,RHO	.3127641+03	-.3394265-00	.3408202+03	-.3175885-00	.3186011+03	-.2631857-00	.2811211+03	-.1877356-00	.2849339+03
SQR ROOTS OF DIAG	.1299842-01	.1334806-01	.1429382-01	.9665911-02	.1295649-01	.1250936-01	.1157987-01	.1805770-01	.1177452-01

	17	23	23	28	28	34	34	39	39
17	.3472753-03	-.7916237-04	.3610061-03	-.9585267-04	.2650441-03	-.1141900-03	.1909803-03	-.1043893-03	.1846228-03
23	-.7916237-04	.1474359-03	-.8691180-04	.1567947-03	-.6159023-04	.1665939-03	-.4286385-04	.1642768-03	-.3949117-04
23	.3610061-03	-.8691180-04	.3770179-03	-.1074175-03	.2770325-03	-.1296010-03	.2003384-03	-.1195657-03	.1929030-03
28	-.9585267-04	.1567947-03	-.1074175-03	.1729650-03	-.7709647-04	.1895734-03	-.5534271-04	.1870564-03	-.5013789-04
28	.2650441-03	-.6159023-04	.2770325-03	-.7709647-04	.2040455-03	-.9386333-04	.1485463-03	-.8672678-04	.1429637-03
34	-.1141900-03	.1665939-03	-.1296010-03	.1895734-03	-.9386333-04	.2130018-03	-.6879000-04	.2102539-03	-.6173991-04
34	.1909803-03	-.4286386-04	.2003384-03	-.5534271-04	.1485463-03	-.6879000-04	.1102521-03	-.6414772-04	.1058659-03
39	-.1043893-03	.1642768-03	-.1195657-03	.1870564-03	-.8672679-04	.2102539-03	-.6414772-04	.2079018-03	-.5719969-04
39	.1846228-03	-.3949117-04	.1929030-03	-.5013789-04	.1429637-03	-.6173991-04	.1058659-03	-.5719969-04	.1019918-03
EIGENVALUES	.1226612-03	.4062083-03	.1182455-03	.2671523-03	.1096582-03	.2474840-03	.7576988-04	.2328957-03	.7699787-04
BETA,RHO	-.2730241-00	.2885652+03	-.3686346-00	.3093018+03	-.4103864-00	.3333769+03	-.4488903-00	.3363966+03	-.3928094-00
SQR ROOTS OF DIAG	.1863532-01	.1214232-01	.1941695-01	.1315162-01	.1428445-01	.1459456-01	.1050010-01	.1441880-01	.1009910-01

17	-.8386725-04	.2483146-03	-.9332392-04	.1769921-03	-.7323922-04	.2323437-03	-.4478296-04	.3356799-03	-.5990749-04
23	.1542915-03	-.5458609-04	.1619244-03	-.3542759-04	.1524337-03	-.4792709-04	.1388491-03	-.7266927-04	.1424426-03
23	-.9536540-04	.2584624-03	-.1083248-03	.1839741-03	-.8481793-04	.2407353-03	-.5138935-04	.3477027-03	-.6695698-04
28	.1706460-03	-.6713042-04	.1846339-03	-.4386764-04	.1691988-03	-.5764268-04	.1469437-03	-.8618713-04	.1509895-03
28	-.6853231-04	.1903018-03	-.7876014-04	.1362595-03	-.6108505-04	.1771846-03	-.3595513-04	.2550819-03	-.4717619-04
34	.1873917-03	-.8088426-04	.2077263-03	-.5324732-04	.1863135-03	-.6851940-04	.1553466-03	-.1013059-03	.1599031-03
34	-.4980935-04	.1382556-03	-.5903746-04	.1005968-03	-.4512090-04	.1284401-03	-.2533553-04	.1831983-03	-.3297070-04
39	.1853615-03	-.7414050-04	.2058359-03	-.4882921-04	.1847405-03	-.6215216-04	.1542243-03	-.9169852-04	.1582473-03

39	-.4462265-04	.1335405-03	-.5216244-04	.9733944-04	-.3988385-04	.1245528-03	-.2247965-04	.1777424-03	-.2991558-04

MISSION V FRAME 63 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS M

	0	0	1	1	6	6	12	12	17
0	.1652903-03	-.6951107-04	.2293331-03	-.4613587-05	.1886943-03	.1032503-05	.1070310-03	-.2130359-04	.1226941-03
0	-.6951107-04	.1867279-03	-.7184329-04	.7210328-04	-.2223981-04	.1219364-03	.8664590-04	.3154258-03	-.1398448-04
1	.2293331-03	-.7184329-04	.3343710-03	.6036330-05	.2660551-03	.4757793-04	.1309060-03	.8442824-04	.1157634-03
1	-.4613587-05	.7210328-04	.6036330-05	.4449850-04	.1474399-04	.6690994-04	.3815978-04	.1609672-03	-.4855680-05
6	.1886943-03	-.2223981-04	.2660551-03	.1474399-04	.2250884-03	.5493925-04	.1457286-03	.1137779-03	.1169965-03
6	.1032503-05	.1219364-03	.4757793-04	.6690994-04	.5493925-04	.1257468-03	.7906551-04	.3072666-03	-.1096361-04
12	.1070310-03	.8664590-04	.1309060-03	.3815978-04	.1457286-03	.7906551-04	.1809973-03	.1953660-03	.1188651-03
12	-.2130359-04	.3154258-03	.8442824-04	.1609672-03	.1137779-03	.3072666-03	.1953660-03	.7591741-03	-.3197563-04
17	.1226941-03	-.1398448-04	.1157634-03	-.4855680-05	.1169965-03	-.1096361-04	.1188651-03	-.3197563-04	.1288701-03
EIGENVALUES	.2555279-03	.1169484-03	.3344967-03	.4437265-04	.2499818-03	.1013534-03	.8189983-03	.1211731-03	.9676071-03
BETA,RHO	.3197054+03	-.3736919-00	.1192443+01	.4948641-01	.2394158+02	.3265560-00	.7297458+02	.5270385-00	.2729331+03

SQR ROOTS OF DIAG .1361243-01 .1366484-01 .1028501-01 .6670719-02 .1500295-01 .1121369-01 .1345352-01 .2755311-01 .1135210-01

	17	23	23	28	28	34	34	39	39
17	.9664053-03	-.4938946-03	.1275196-02	-.3773198-03	.6827360-03	-.3590424-03	.2939513-03	-.2408765-03	.2352516-03
23	-.4938946-03	.4207955-03	-.7281370-03	.3627086-03	-.3239053-03	.3596613-03	-.1549342-03	.2903292-03	-.1140323-03
23	.1275196-02	-.7281370-03	.1957046-02	-.6314244-03	.8977592-03	-.6674679-03	.4748136-03	-.5078847-03	.3396947-03
28	-.3773198-03	.3627086-03	-.6314244-03	.3364659-03	-.2816214-03	.3513023-03	-.1363289-03	.2933924-03	-.8910310-04
28	.6827360-03	-.3239053-03	.8977592-03	-.2816214-03	.4127002-03	-.2998690-03	.2203504-03	-.2261498-03	.1573369-03
34	-.3590424-03	.3596613-03	-.6674679-03	.3513023-03	-.2998690-03	.3817324-03	-.1512789-03	.3256645-03	-.9150336-04
34	.2939513-03	-.1549342-03	.4748136-03	-.1363289-03	.2203504-03	-.1512789-03	.1299797-03	-.1235280-03	.9265051-04
39	-.2408765-03	.2903292-03	-.5078847-03	.2933924-03	-.2261498-03	.3256645-03	-.1235280-03	.2911623-03	-.7110187-04
39	.2352516-03	-.1140323-03	.3396947-03	-.8910310-04	.1573369-03	-.9150336-04	.9265051-04	-.7110187-04	.7153447-04
EIGENVALUES	.1266683-03	.2247315-02	.1305258-03	.6587723-03	.9037383-04	.4526558-03	.5905628-04	.3121711-03	.5052571-04
BETA,RHO	-.1218356+00	.2917346+03	-.8023744-00	.3111460+03	-.7557493-00	.3348816+03	-.6791426-00	.3435390+03	-.4926696-00

SQR ROOTS OF DIAG .3107097-01 .2051330-01 .4423851-01 .1834301-01 .2031502-01 .1953797-01 .1140086-01 .1706348-01 .8457805-02

17	-.1631579-03	.4239104-03	-.1586430-03	.1625410-03	-.4935810-04	.2822646-03	.1911722-03	.7304403-03	-.4297393-04
23	.2379198-03	-.2124301-03	.2544188-03	-.6259358-04	.1889125-03	-.1121203-03	.4994913-04	-.3073748-03	.1566050-03
23	-.3328609-03	.5660681-03	-.4448434-03	.1713014-03	-.2390880-03	.2652194-03	.1942763-03	.7275529-03	-.5721329-04
28	.2326522-03	-.1624001-03	.2735895-03	-.2973164-04	.2063020-03	-.5397332-04	.6806661-04	-.1694039-03	.1368694-03

28	-.1465244-03	.2592432-03	-.2011029-03	.7885675-04	-.1054955-03	.1199532-03	.9584628-04	.3295624-03	-.1786932-04
34	.2488822-03	-.1559606-03	.3173450-03	-.1645092-04	.2370991-03	-.2430074-04	.7476268-04	-.1031024-03	.1269145-03
34	-.7627060-04	.1331045-03	-.1235966-03	.4622873-04	-.6916055-04	.5360322-04	.4560906-04	.1474559-03	-.1782914-05
39	.2246837-03	-.1053629-03	.3005610-03	-.5249598-05	.2336928-03	.7425026-05	.9961334-04	-.1719268-04	.1194475-03
39	-.4458091-04	.1058571-03	-.6614877-04	.4536466-04	-.3206745-04	.5937316-04	.4201654-04	.1530904-03	-.3329756-05

MISSION II FRAME 102 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS I

	0	0	1	1	6	6	12	12	17
0	.6141326-02	.7994663-02	.9591980-02	.1429450-01	.5493180-02	.1095542-01	.2670751-02	.9532937-02	.2794953-02
0	.7994663-02	.2569621-01	.2031436-01	.3658058-01	.1078989-01	.2822020-01	.4741388-02	.2450082-01	.4555181-02
1	.9591980-02	.2031436-01	.1841475-01	.2909284-01	.1030168-01	.2236436-01	.5116198-02	.1946920-01	.4961014-02
1	.1429450-01	.3658058-01	.2909284-01	.5210184-01	.1549713-01	.4017567-01	.6862636-02	.3486906-01	.6599133-02
6	.5493180-02	.1078989-01	.1030168-01	.1549713-01	.5875309-02	.1188610-01	.3043534-02	.1034765-01	.2959910-02
6	.1095542-01	.2822020-01	.2236436-01	.4017567-01	.1188610-01	.3099556-01	.5229802-02	.2691535-01	.5024905-02
12	.2670751-02	.4741388-02	.5116197-02	.6862636-02	.3043534-02	.5229802-02	.1713360-02	.4550429-02	.1676867-02
12	.9532937-02	.2450082-01	.1946920-01	.3486906-01	.1034765-01	.2691535-01	.4550429-02	.2339465-01	.4368281-02
17	.2794953-02	.4555181-02	.4961014-02	.6599133-02	.2959910-02	.5024905-02	.1676867-02	.4368281-02	.1692413-02
EIGENVALUES	.2971989-01	.1117644-02	.6887523-01	.1691361-02	.3572809-01	.1192773-02	.2431096-01	.7970498-03	.2168518-01
BETA,RMO	.6797139+02	.8652029-00	.6003453+02	.9392401-00	.6628967+02	.8807939-00	.7861473+02	.7187367-00	.7842564+02
SQR ROOTS OF DIAG	.1710304-01	.1603004-00	.1357009-00	.2262583-00	.7665056-01	.1760556-00	.4139275-01	.1529531-00	.4052670-01

	17	23	23	28	28	34	34	39	39
17	.2084449-01	.3666843-02	.1992671-01	.8203594-02	.2109103-01	.1795348-01	.2761028-01	.1813758-01	.2994207-01
23	.3666843-02	.1556313-02	.3579431-02	.2539396-02	.3894816-02	.4734511-02	.5226913-02	.4739731-02	.5670376-02
23	.1992871-01	.3579431-02	.1811210-01	.7611404-02	.1966655-01	.1667951-01	.2574590-01	.1685061-01	.2791618-01
28	.8203595-02	.2539396-02	.7611404-02	.4474013-02	.8264356-02	.8798890-02	.1096352-01	.8839157-02	.1190053-01
28	.2109103-01	.3894816-02	.1966655-01	.8264356-02	.2137590-01	.1809624-01	.2800761-01	.1827632-01	.3035812-01
34	.1795348-01	.4734511-02	.1667951-01	.8798890-02	.1809624-01	.1789526-01	.2387604-01	.1801331-01	.2591890-01
34	.2761028-01	.5226913-02	.2574590-01	.1096352-01	.2800761-01	.2387604-01	.3674305-01	.2410166-01	.3981519-01
39	.1813758-01	.4739731-02	.1685061-01	.8839157-02	.1827632-01	.1801331-01	.2410166-01	.1813543-01	.2616655-01
39	.2994207-01	.5670376-02	.2791618-01	.1190053-01	.3035812-01	.2591890-01	.3981519-01	.2616655-01	.4315189-01
EIGENVALUES	.8017271-03	.1885285-01	.8155680-03	.2475519-01	.1104718-02	.5298772-01	.1650593-02	.5969614-01	.1641175-02
BETA,RMO	.7015505-00	.7630797+02	.6741880-00	.6781977+02	.8450807-00	.5576960+02	.9311201-00	.5777446+02	.9353682-00
SQR ROOTS OF DIAG	.1443762-00	.3545019-01	.1345312-00	.6680806-01	.1462050-00	.1337732-00	.1916848-00	.1346678-00	.2077303-00

17	.8971376-02	.2513170-01	.1833638-01	.3291800-01	.9738815-02	.2540886-01	.4276203-02	.2208179-01	.4104836-02
23	.2692348-02	.4295984-02	.4740212-02	.6232492-02	.2847824-02	.4738676-02	.1629236-02	.4115457-02	.1597518-02
23	.8325103-02	.2156631-01	.1703517-01	.3068692-01	.9038382-02	.2366501-01	.3959469-02	.2057945-01	.3800449-02
28	.4792571-02	.9099024-02	.8886316-02	.1309164-01	.5114194-02	.1002437-01	.2700490-02	.8717945-02	.2631515-02
28	.9033414-02	.2343501-01	.1847017-01	.3335913-01	.9802003-02	.2573364-01	.4299296-02	.2233758-01	.4130471-02
34	.9487771-02	.1990253-01	.1819618-01	.2851956-01	.1018085-01	.2190986-01	.5092339-02	.1906235-01	.4940283-02
34	.1196582-01	.3070351-01	.2434448-01	.4373718-01	.1296765-01	.3371224-01	.5747958-02	.2923950-01	.5530270-02
39	.9536031-02	.2010077-01	.1827270-01	.2879542-01	.1023702-01	.2212855-01	.5103330-02	.1925790-01	.4948844-02

39	.1299097-01	.3328499-01	.2643332-01	.4741147-01	.1408117-01	.3655131-01	.6239370-02	.3171238-01	.6001543-02

MISSION V FRAME 102 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS *

	0	0	1	1	6	6	12	12	17
0	.6399366-02	.1056067-01	.3811725-01	.7594913-01	.6412279-02	.1957776-01	.1543815-02	.1366715-01	.1060999-02
0	.1056067-01	.2736537-01	.9001046-01	.1928797-00	.1286620-01	.5031804-01	.1460632-02	.3446960-01	.5544324-03
1	.3811726-01	.9001046-01	.3072311-00	.6915600-00	.4642229-01	.1667721-00	.7231852-02	.1152009+00	.3723587-02
1	.7594913-01	.1928797-00	.6915600-00	.1365749+01	.9285520-01	.3559306-00	.1135298-01	.2444577-00	.4586418-02
6	.6412279-02	.1286620-01	.4642229-01	.9285520-01	.7701675-02	.2396249-01	.1756553-02	.1674811-01	.1149270-02
6	.1957776-01	.5031804-01	.1667721-00	.3559306-00	.2396249-01	.9288200-01	.2744596-02	.6374454-01	.1018087-02
12	.1543815-02	.1460632-02	.7231852-02	.1135298-01	.1756553-02	.2744596-02	.8407366-03	.2069654-02	.6854967-03
12	.1366715-01	.3446960-01	.1152009+00	.2444577-00	.1674811-01	.6374454-01	.2069654-02	.4366632-01	.8238227-03
17	.1060999-02	.5544324-03	.3723587-02	.4586418-02	.1149270-02	.1018087-02	.6854967-03	.8238227-03	.5961469-03
EIGENVALUES	.3160274-01	.1147013-02	.1668217+01	.4803667-02	.9916027-01	.1423432-02	.4396565-01	.7414098-03	.2256460-01
BETA,KHO	.6807181+02	.6685360-00	.6476110+02	.9904052-00	.7531830+02	.8956278-00	.8725237+02	.3408020-00	.8858807+02
SQR ROOTS OF DIAG	.7944648-01	.1653946-00	.5542843-00	.1168670+01	.8775930-01	.3047655-00	.2899546-01	.2044429-00	.2441616-01

	17	23	23	26	28	34	34	39	39
17	.2253126-01	-.2303070-02	.1502507-01	.5633428-02	.1236240-01	.7652895-01	.4955420-01	.6563057-01	.7333911-01
23	-.2303070-02	.9189723-03	-.1684106-02	-.4639286-03	-.1341889-02	-.3492421-02	-.2930784-02	-.4372481-02	-.6417299-02
23	.1502507-01	-.1684106-02	.1013456-01	.3459429-02	.8411929-02	.4969561-01	.2942284-01	.4287089-01	.4878739-01
26	.5633628-02	.4639286-03	.3459429-02	.3039177-02	.2650665-02	.7124382-02	.4076013-01	.2487321-01	.1985406-01
28	.1236240-01	-.1341889-02	.8411929-02	.2650665-02	.7124382-02	.4076013-01	.2487321-01	.3502577-01	.4050918-01
34	.7652895-01	-.3492421-02	.4969561-01	.2599793-01	.4076013-01	.2093175-00	.1606333-00	.2392992-00	.2552407-00
34	.4955420-01	-.2930784-02	.2942284-01	.1340549-01	.2487321-01	.1606333-00	.9335721-01	.1341653-00	.1485179-00
39	.6563057-01	-.4372481-02	.4287089-01	.2021725-01	.3502578-01	.2392992-00	.1341653-00	.2005957-00	.2165416-00
39	.7333911-01	-.6417299-02	.4878739-01	.1985406-01	.4050918-01	.2552407-00	.1485179-00	.2165416-00	.2411238-00
EIGENVALUES	.5028024-03	.1043268-01	.6208530-03	.8588720-02	.1574840-02	.3794947-00	.3180064-02	.4383475-00	.3372034-02
BETA,KHO	.1476777-00	.2800385+03	-.5518440-00	.6281137+02	.6126291-00	.2930920+02	.9774044-00	.4767310+02	.9846016-00
SQR ROOTS OF DIAG	.1501738-00	.3031456-01	.1006706+00	.5612873-01	.6440605-01	.6378824-00	.3056441-00	.4478791-00	.4910436-00

	17	23	23	26	28	34	34	39	39
17	.9683805-02	.2477382-01	.8228374-01	.1753330-00	.1187307-01	.4571057-01	.1420947-02	.3142189-01	.5414740-03
23	-.1307131-03	-.2499526-02	-.6703391-02	-.1738365-01	-.3634604-03	-.4696360-02	-.6082562-03	-.3156093-02	-.5569375-03
23	.6155410-02	.1656398-01	.5399124-01	.1166229+00	.7566101-02	.3041608-01	.7529599-03	.2083875-01	.1995445-03
28	.3806337-02	.6185754-02	.2349613-01	.4467012-01	.4378213-02	.1140264-01	.1389968-02	.7992128-02	.1087629-02

	28	34	34	39	39
28	.4976859-02	.1376609-01	.4399127-01	.9613175-01	.6048686-02	.2509416-01	.5363507-03	.1707886-01	.1373490-03
34	.3880200-01	.8391301-01	.2922275-00	.5988044-00	.4644118-01	.1549387-00	.9300929-02	.1072714+00	.5885415-02
34	.2075807-01	.4938465-01	.1650903-00	.3481977-00	.2481884-01	.9032456-01	.4058928-02	.6194312-01	.2359498-02
39	.3159714-01	.7186727-01	.2473753-00	.5124971-00	.3818979-01	.1325796-00	.6676562-02	.9194081-01	.3827768-02
39	.3257605-01	.8092483-01	.2694207-00	.5719631-00	.3949092-01	.1488354-00	.5389855-02	.1021913+00	.2586661-02

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MISSION IV FRAME 109 APOLLO
TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.8893317-04	-.2278983-04	.1046905-03	-.2120810-04	.9022192-04	-.1946734-04	.7435079-04	-.1987401-04	.7466106-04
0	-.2278983-04	.7751896-04	-.4097022-04	.8702051-04	-.2607950-04	.7490871-04	-.9989110-05	.6671398-04	-.8837862-05
1	.1046905-03	-.4097022-04	.1292587-03	-.4112525-04	.1072532-03	-.3607879-04	.8311110-04	-.3409886-04	.8305566-04
1	-.2120810-04	.8702051-04	-.4112525-04	.1039129-03	-.2619907-04	.8504812-04	-.1009579-04	.6956893-04	-.7470347-05
6	.9022192-04	-.2607950-04	.1072532-03	-.2619907-04	.9200315-04	-.2272763-04	.7527563-04	-.2134358-04	.7523067-04
6	-.1946734-04	.7490871-04	-.3607879-04	.8504812-04	-.2272763-04	.7270667-04	-.8329306-05	.6401001-04	-.7051085-05
12	.7435079-04	-.9989110-05	.8311110-04	-.1009579-04	.7527563-04	-.8329307-05	.6668808-04	-.7592239-05	.6665522-04
12	-.1987401-04	.6671398-04	-.3409886-04	.6956893-04	-.2134358-04	.6401001-04	-.7592239-05	.6274010-04	-.7829759-05
17	.7466106-04	-.8837862-05	.8305566-04	-.7470347-05	.7523067-04	-.7051085-05	.6665522-04	-.7829760-05	.6693589-04
EIGENVALUES	.1067196-03	.5973250-04	.1596193-03	.7355221-04	.1070457-03	.5766415-04	.7255875-04	.5686943-04	.7724148-04
BETA,RHO	.3220295+03	-.2744766-00	.3235634+03	-.3548493-00	.3265010+03	-.2778854-00	.3222071+03	-.1173743+00	.3128146+03
SQR ROOTS OF DIAG	.9430438-02	.8804485-02	.1136920-01	.1019377-01	.9591827-02	.8526821-02	.8166277-02	.7920865-02	.8181436-02

	17	23	23	28	28	34	34	34	39
17	.6039544-04	-.9863199-05	.7202117-04	-.2158175-04	.7292932-04	-.3707797-04	.7967139-04	-.3789412-04	.7649051-04
23	-.9863190-05	.6825785-04	-.1194101-04	.7515069-04	-.9470971-05	.8415036-04	-.7645068-05	.8363646-04	-.6152796-05
23	.7202117-04	-.1194101-04	.7612269-04	-.2523081-04	.7712789-04	-.4277324-04	.8431482-04	-.4364590-04	.8073506-04
28	-.2158175-04	.7515069-04	-.2523081-04	.8723458-04	-.2303882-04	.1029929-03	-.2260595-04	.1026520-03	-.1979747-04
28	.7292932-04	-.9470970-05	.7712789-04	-.2303882-04	.8326211-04	-.4093853-04	.9714217-04	-.4318210-04	.9346260-04
34	-.3707797-04	.8415036-04	-.4277324-04	.1029929-03	-.4093853-04	.1275526-03	-.4233340-04	.1274378-03	-.3781048-04
34	.7967139-04	-.7645068-05	.8431482-04	-.2260595-04	.9714217-04	-.4233340-04	.1202325-03	-.4641508-04	.1161459-03
39	-.3789412-04	.8363646-04	-.4364590-04	.1026520-03	-.4318210-04	.1274378-03	-.4641508-04	.1276946-03	-.4183895-04
39	.7649051-04	-.6152796-05	.8073506-04	-.1979747-04	.9346260-04	-.3781048-04	.1161459-03	-.4183895-04	.1123975-03
EIGENVALUES	.5808984-04	.8476213-04	.5961841-04	.1083726-03	.6212406-04	.1663839-03	.8140122-04	.1625784-03	.7751375-04
BETA,RHO	-.1411133-00	.3058861+03	-.1656562-00	.3174637+03	-.2703287-00	.3174707+03	-.3418437-00	.3201799+03	-.3492337-00
SQR ROOTS OF DIAG	.8270153-02	.8261831-02	.8724832-02	.9339945-02	.9124807-02	.1129392-01	.1096506-01	.1130020-01	.1060177-01

17	-.2305346-04	.6983575-04	-.3893030-04	.7267457-04	-.2469159-04	.6679166-04	-.9311049-05	.6540461-04	-.9547972-05
23	.7515844-04	-.7485892-05	.8314419-04	-.4344441-05	.7530410-04	-.5540477-05	.6671273-04	-.8139569-05	.6737023-04
23	-.2688894-04	.7361904-04	-.4476065-04	.7643881-04	-.2873047-04	.7016423-04	-.1138254-04	.6863633-04	-.1161898-04
28	.8784605-04	-.1967772-04	.1024031-03	-.1640406-04	.8865120-04	-.1637106-04	.7356565-04	-.1855681-04	.7423011-04
28	-.2616920-04	.8018295-04	-.4593858-04	.8905098-04	-.2949094-04	.7716104-04	-.1168959-04	.6946370-04	-.1066479-04
34	.1043893-03	-.3578556-04	.1275069-03	-.3235251-04	.1060524-03	-.3070442-04	.8250704-04	-.3235841-04	.8318345-04
34	-.2776436-04	.9434472-04	-.6137855-04	.1112515-03	-.3313933-04	.9161315-04	-.1339858-04	.7583781-04	-.1076692-04
39	.1044522-03	-.3811734-04	.1282092-03	-.3631830-04	.1065226-03	-.3312774-04	.8272626-04	-.3312777-04	.8306956-04

39	-.2479450-04	.9101292-04	-.4673068-04	.1079102-03	-.2999465-04	.8862658-04	-.1190425-04	.7298718-04	-.9275892-05

MISSION V FRAME 109 APOLLO

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS M

	0	0	1	1	6	6	12	12	17
0	.9873570-04	-.2856404-04	.1541285-03	-.1219418-04	.1064391-03	.1030610-05	.6109870-04	-.6386071-06	.6263987-04
0	-.2856404-04	.8253504-04	-.1006332-03	.9616843-04	-.4913194-04	.5656883-04	-.2066287-05	.4562293-04	.2870351-05
1	.1541285-03	-.1006332-03	.3187521-03	-.9897265-04	.2003906-03	-.3119980-04	.8842692-04	-.2067267-05	.6961914-04
1	-.1219418-04	.9616843-04	-.9897265-04	.1615560-03	-.6091539-04	.8569765-04	-.2774524-04	.3751357-04	.2505022-05
6	.1064391-03	-.4913194-04	.2003906-03	-.6091539-04	.1398524-03	-.1534302-04	.8264706-04	.1182229-04	.6429520-04
6	.1030610-05	.5656883-04	-.3119980-04	.8569765-04	-.1534302-04	.5394711-04	-.2342305-05	.3992405-04	.5018836-05
12	.6109870-04	-.2066287-05	.8842692-04	-.2774524-04	.8264706-04	-.2342305-05	.7739269-04	.2321551-04	.5939734-04
12	-.6386072-06	.4562293-04	-.2067267-05	.3751357-04	.1182229-04	.3992405-04	.2321551-04	.6141289-04	.5719627-05
17	.6263987-04	.2870351-05	.6961914-04	.2505022-05	.6429520-04	.5018836-05	.5939734-04	.5719627-05	.6893488-04
EIGENVALUES	.1203258-03	.6094497-04	.3665394-03	.1137688-03	.1425105-03	.5128903-04	.9395474-04	.4485083-04	.8794709-04
BETA,RHO	.3229163+03	-.3164196-00	.3342272+03	-.4361412-00	.3501714+03	-.1766411-00	.3550423+02	.3367430-00	.8659221+02

SQR ROOTS OF DIAG	.9936584-02	.9084879-02	.1785363-01	.1271047-01	.1182592-01	.7344870-02	.8797312-02	.7836637-02	.7676906-02

	17	23	23	28	28	34	34	39	39
17	.8784422-04	-.2273091-04	.1163304-03	-.4190323-04	.9802203-04	-.6784346-04	.1067327-03	-.6830292-04	.8075801-04
23	-.2273091-04	.9276122-04	-.3223652-04	.1005179-03	-.3188438-05	.1123725-03	.3221248-04	.8618867-04	.3410081-04
23	.1163304-03	-.3223652-04	.1737399-03	-.7538090-04	.1538412-03	-.1373185-03	.1742592-03	-.1395625-03	.1246417-03
28	-.4190323-04	.1005179-03	-.7538090-04	.1288275-03	-.4410813-04	.1697964-03	-.1486674-04	.1446278-03	.6474139-05
28	.9802203-04	-.3188436-05	.1538412-03	-.4410813-04	.1594232-03	-.1022928-03	.2142405-03	-.1289064-03	.1644745-03
34	-.6784345-04	.1123725-03	-.1373185-03	.1697964-03	-.1022928-03	.2520269-03	-.8112783-04	.2278101-03	-.3225834-04
34	.1067327-03	.3221248-04	-.1742592-03	.1486674-04	-.2142405-03	.8112783-04	.3312199-03	-.1480822-03	.2684219-03
39	-.6830292-04	.8618867-04	-.1395625-03	.1446278-03	-.1289064-03	.2278101-03	-.1480822-03	.2305174-03	-.9395335-04
39	.8075801-04	.3410081-04	.1246417-03	.6474139-05	.1644745-03	-.3225834-04	.2684219-03	-.9395335-04	.2263442-03
EIGENVALUES	.5883200-04	.1850055-03	.8149556-04	.1908110-03	.9743968-04	.3818986-03	.2013482-03	.3224073-03	.1344543-03
BETA,RHO	.2401052-01	.2892629+03	-.2539307-00	.3054361+03	-.3077788-00	.3019921+03	-.2807942-00	.3156361+03	-.4113161-00

SQR ROOTS OF DIAG	.9372525-02	.9631262-02	.1318104-01	.1135022-01	.1262629-01	.1587535-01	.1819945-01	.1518280-01	.1504474-01

17	-.3017754-04	.7033582-04	-.7156681-04	.5087337-04	-.2408979-04	.4309868-04	.1937112-04	.6446358-04	.1727604-05
23	.7331834-04	-.5561925-05	.4307363-04	-.3752089-04	.5231479-04	-.1430292-04	.9214072-04	-.1968742-04	.6261724-04
23	-.6517041-04	.1001957-03	-.1541277-03	.6702617-04	-.6449897-04	.4721309-04	.1528335-04	.6870511-04	-.2751519-05
28	.1016604-03	-.1372199-04	.1283053-03	.3285029-04	.8638949-04	.6653065-04	.4426619-04	-.1374189-04	.6560803-04

28	-.6847990-04	.1091383-03	-.1710203-03	.1075309-03	-.8349318-04	.5946202-04	-.2017038-05	.5159219-04	.6129913-06
34	.1421193-03	-.4119536-04	.2206064-03	.2661872-04	.1320400-03	.1959196-04	.4703563-04	.1315441-04	.7008362-04
34	-.6525099-04	.1568140-03	-.2386131-03	.1978594-03	-.1277674-03	.9865759-04	-.2522774-04	.8047203-04	.4215061-05
39	.1417864-03	-.6613232-04	.2547674-03	-.2999409-04	.1566844-03	-.3934492-05	.6325012-04	-.8400177-05	.6717051-04
39	-.4103989-04	.1276988-03	-.1740402-03	.1798928-03	-.9683105-04	.9201339-04	-.2632447-04	.4423705-04	.3231467-05

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MISSION V FRAME 130 ADDITIONAL

TELEPHOTO LENS

COVARIANCE MATRIX OF TOTAL ERRORS T

	0	0	1	1	6	6	12	12	17
0	.4072290-03	-.2327840-03	.4997725-03	-.2088945-03	.4162316-03	-.1955659-03	.3172397-03	-.2212377-03	.3219577-03
0	-.2327840-03	.7108422-03	-.3052788-03	.6739504-03	-.2350033-03	.6802936-03	-.1567046-03	.7625586-03	-.1662569-03
1	.4997725-03	-.3052788-03	.6295858-03	-.2699191-03	.5101282-03	-.2522507-03	.3679531-03	-.2867348-03	.3740952-03
1	-.2088945-03	.6739504-03	-.2699191-03	.6598445-03	-.2129192-03	.6507197-03	-.1499030-03	.7084780-03	-.1561389-03
6	.4162316-03	-.2350033-03	.5101282-03	-.2129192-03	.4239298-03	-.1968240-03	.3216241-03	-.2199364-03	.3260270-03
6	-.1955659-03	.6802935-03	-.2522507-03	.6507197-03	-.1968240-03	.6564957-03	-.1362863-03	.7322315-03	-.1498625-03
12	.3172397-03	-.1567046-03	.3679531-03	-.1499030-03	.3216241-03	-.1362863-03	.2672005-03	-.1470184-03	.2696674-03
12	-.2212377-03	.7625586-03	-.2867348-03	.7084780-03	-.2199364-03	.7322315-03	-.1470184-03	.8391631-03	-.1596228-03
17	.3219577-03	-.1662569-03	.3740952-03	-.1561389-03	.3260270-03	-.1498625-03	.2696674-03	-.1596228-03	.2726670-03
EIGENVALUES	.8374000-03	.2826712-03	.9150579-03	.3743724-03	.7668203-03	.3116052-03	.8747401-03	.2316236-03	.9912523-03
BETA,RHO	.2985316+03	-.4316018-00	.3133959+03	-.4187794-00	.2997128+03	-.3730913-00	.2836035+03	-.3104772-00	.2852214+03
SQR ROOTS OF DIAG	.2022741-01	.2666162-01	.2509155-01	.2568744-01	.2058956-01	.2562217-01	.1634627-01	.2896831-01	.1651263-01

	17	23	23	28	28	34	34	39	39
17	.2917532-03	-.1990280-03	.9262922-03	-.2613439-03	.8251942-03	-.3444563-03	.7856117-03	-.3417614-03	.7601750-03
23	-.1990280-03	.2430267-03	-.2260461-03	.3271574-03	-.2016965-03	.3820928-03	-.2020527-03	.3822177-03	-.1852825-03
23	.9262922-03	-.2260461-03	.9693211-03	-.3039896-03	.8627109-03	-.4056751-03	.8226795-03	-.4032792-03	.7914103-03
28	-.2613439-03	.3271574-03	-.3039896-03	.4003277-03	-.2693230-03	.4900981-03	-.2684656-03	.4903605-03	-.2486532-03
28	.8251942-03	-.2016965-03	.8627109-03	-.2693230-03	.7791999-03	-.3576146-03	.7575562-03	-.3572585-03	.7306030-03
34	-.3444563-03	.3820928-03	-.4056751-03	.4900981-03	-.3576146-03	.5945031-03	-.3568235-03	.6221046-03	-.3138534-03
34	.7856117-03	-.2020527-03	.8226795-03	-.2684656-03	.7575562-03	-.3568235-03	.7568907-03	-.3568235-03	.7297928-03
39	-.3417614-03	.3822177-03	-.4032792-03	.4903605-03	-.3572585-03	.6221046-03	-.3568235-03	.6228138-03	-.3161731-03
39	.7601750-03	-.1852825-03	.7914103-03	-.2486532-03	.7306030-03	-.3138534-03	.7297928-03	-.3161731-03	.7077546-03
EIGENVALUES	.2231670-03	.1037084-02	.2152641-03	.9190371-03	.2604905-03	.1049617-02	.3280381-03	.9842970-03	.3462719-03
BETA,RHO	-.3689254-00	.2866073+03	-.4315682-00	.2979391+03	-.4822155-00	.3096439+03	-.5171028-00	.3111747+03	-.4762165-00
SQR ROOTS OF DIAG	.2986224-01	.1682340-01	.3113392-01	.2000819-01	.2791415-01	.2493524-01	.2749347-01	.2495624-01	.2660366-01

17	-.2588707-03	.7882222-03	-.3399315-03	.7289731-03	-.2588136-03	.7515179-03	-.1686759-03	.8623307-03	-.1819186-03
23	.3292699-03	-.1708087-03	.3836162-03	-.1645673-03	.3330021-03	-.1560379-03	.2737725-03	-.1757597-03	.2779330-03
23	-.3026264-03	.8183308-03	-.4018257-03	.7530217-03	-.3040139-03	.7741905-03	-.1938039-03	.8895827-03	-.2077963-03
28	.4044745-03	-.2327155-03	.4923767-03	-.2067821-03	.4108337-03	-.1961646-03	.3143755-03	-.2246677-03	.3194986-03
28	-.2780577-03	.7416730-03	-.3583065-03	.6976193-03	-.2732374-03	.7044012-03	-.1772479-03	.7931771-03	-.1877727-03
34	.4963478-03	-.3044223-03	.6247627-03	-.2637235-03	.5069347-03	-.2512185-03	.3696965-03	-.2916757-03	.3716352-03
34	-.2721300-03	.7224524-03	-.3610813-03	.6977578-03	-.2782060-03	.6876371-03	-.1841067-03	.7539488-03	-.1916750-03
39	.4972254-03	-.3042414-03	.6259221-03	-.2660422-03	.5070333-03	-.2512161-03	.3656377-03	-.2888922-03	.3722033-03

39	-.2438224-03	.7006676-03	-.3202604-03	.6807199-03	-.2489797-03	.6710431-03	-.1688081-03	.7335151-03	-.1757789-03

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MISSION V FRAME 130 ADDITIONAL

WIDE ANGLE LENS

COVARIANCE MATRIX OF TOTAL ERRORS

	0	0	1	1	6	6	12	12	17
0	.4800023-03	-.2627759-03	.8304669-03	-.1068678-03	.5509229-03	.9746201-04	.2105665-03	.6915741-04	.2491554-03
0	-.2627759-03	.7332379-03	-.5318276-03	.6508443-03	-.2861293-03	.5032114-03	-.1050045-04	.8016270-03	-.1195402-03
1	.8304669-03	-.5318276-03	.1598984-02	-.1862930-03	.9949837-03	.2511275-03	.2531252-03	.2199049-03	.3173577-03
1	-.1068678-03	.6508443-03	-.1862930-03	.8690613-03	-.1472492-03	.7117200-03	-.1242416-03	.8683115-03	-.1560063-03
6	.5509229-03	-.2861293-03	.9949837-03	-.1472492-03	.6639807-03	.1432543-03	.2563959-03	.1837020-03	.2725622-03
6	.9746201-04	.5032114-03	.2511275-03	.7117200-03	.1432543-03	.7479777-03	-.1836600-04	.9932503-03	-.7585294-04
12	.2105665-03	-.1050045-04	.2531252-03	-.1242416-03	.2563959-03	-.1836600-04	.2596369-03	.9057273-04	.2234153-03
12	.6915741-04	.8016270-03	.2199049-03	.8683115-03	.1837020-03	.9932503-03	.9057273-04	.1534035-02	-.7579211-04
17	.2491554-03	-.1195402-03	.3173577-03	-.1560063-03	.2725622-03	-.7585294-04	.2234153-03	-.7579211-04	.2303713-03
EIGENVALUES	.8983104-03	.3149298-03	.1643781-02	.8242644-03	.8552630-03	.5566954-03	.1540490-02	.2532320-03	.1526906-02
BETA;RHO	.3021365+03	-.4429364-00	.3464791+03	-.1580335-00	.5316989+02	.2032757-00	.8595503+02	.1435148-00	.2767934+03
SQR ROOTS OF DIAG	.2190895-01	.2707837-01	.3998730-01	.2947985-01	.2576782-01	.2734918-01	.1611325-01	.3916676-01	.1517799-01

	17	23	23	28	28	34	34	39	39
17	.1508567-02	-.4959909-03	.1838935-02	-.5199041-03	.1327690-02	-.6494614-03	.1240031-02	-.6252297-03	.1042846-02
23	-.4959909-03	.4604754-03	-.7427921-03	.4971931-03	-.5065499-03	.5869644-03	-.4985398-03	.5506805-03	-.3492190-03
23	.1838935-02	-.7427921-03	.2729964-02	-.9804137-03	.1977270-02	-.1391026-02	.1854939-02	-.1359937-02	.1374675-02
28	-.5199041-03	.4971931-03	-.9804136-03	.6299479-03	-.6800874-03	.8347870-03	-.6886897-03	.8031466-03	-.3962956-03
28	.1327690-02	-.5065499-03	.1977270-02	-.6800874-03	.1466537-02	-.9759294-03	.1431121-02	-.9801032-03	.1088438-02
34	-.6494614-03	.5869644-03	-.1391026-02	.8347870-03	-.9759294-03	.1187487-02	-.8796501-03	.1148499-02	-.5189876-03
34	.1240031-02	-.4985398-03	.1854939-02	-.6886897-03	.1431121-02	-.8796501-03	.1484992-02	-.9287656-03	.1165609-02
39	-.6252297-03	.5506805-03	-.1359937-02	.8031466-03	-.9801032-03	.1148499-02	-.9287656-03	.1132434-02	-.5767321-03
39	.1042846-02	-.3492190-03	.1374675-02	-.3962956-03	.1088438-02	-.5189876-03	.1165609-02	-.5767322-03	.9997867-03
EIGENVALUES	.2119724-03	.2951459-02	.2387805-03	.1897314-02	.2496700-03	.2226378-02	.4441009-03	.1695650-02	.4866709-03
BETA;RHO	-.2619991-00	.2866042+03	-.6624996-00	.2991801+03	-.7076041-00	.3102009+03	-.6624200-00	.3182857+03	-.5410787-00
SQR ROOTS OF DIAG	.3883951-01	.2145869-01	.5224906-01	.2508860-01	.3830844-01	.3445993-01	.3853560-01	.3365165-01	.3161940-01

17	-.3750302-03	.1016177-02	-.7263835-03	.7787039-03	-.3602721-03	.6587739-03	.4770228-04	.1193034-02	-.1544499-03
23	.4167192-03	-.3195439-03	.6279238-03	-.2098560-03	.4371032-03	-.9734853-04	.2171593-03	-.2295984-03	.2846545-03
23	-.7822102-03	.1238077-02	-.1599626-02	.7099203-03	-.8554782-03	.3686891-03	.2208911-04	.9179405-03	-.2205863-03
28	.5367282-03	-.3301960-03	.9155135-03	-.9581485-04	.5897031-03	.8770625-04	.1973577-03	-.2201317-04	.2712349-03

28	-.5635378-03	.9338907-03	-.1186521-02	.6069617-03	-.6437424-03	.3063436-03	-.1146729-05	.6551421-03	-.1552880-03
34	.7159497-03	-.4087080-03	.1320184-02	-.8129979-05	.8065118-03	.2693424-03	.1792963-03	.1506121-03	.2748636-03
34	-.5423904-03	.4358055-03	-.1179365-02	.7300041-03	-.6691069-03	.3535191-03	-.6086379-04	.6010147-03	-.1601793-03
39	.7078125-03	-.4234943-03	.1329326-02	-.7753967-04	.8208146-03	.2419451-03	.1979924-03	.1684007-03	.2733973-03
39	-.3618404-03	.8126026-03	-.7665659-03	.7810673-03	-.4493349-03	.4967933-03	-.8136367-04	.7052801-03	-.1586933-03

Appendix G, cont'd

Discussion:

The photo errors are generally correlated because of correlation within the input errors $[N]$ and $[R]_{T \text{ or } W}$, and because terms in the sensitivity matrix $[S]_{T \text{ or } W}$ are correlated. This is so as the perturbation of any of the eleven EVAL Program error-producing inputs perturbs at once the entire photo frame, T or W. Correlation coefficients are therefore expected to be high (>0.8) between points for the same photo parameter, as verified by spot-checking some correlation coefficients for the total error for Mission III, Frame 69. For the telephoto lens:

$$\rho_{\substack{2\mu \\ 1\mu}} = \frac{.302\times10^{-4}}{.609\times10^{-2}\cdot.528\times10^{-2}} = 0.940$$ between frame points for the same parameter(μ)

$$\rho_{\substack{2\mu \\ 6\mu}} = \frac{.355\times10^{-4}}{.609\times10^{-2}\cdot.584\times10^{-2}} = 0.999$$ between frame points for the same parameter(μ)

$$\rho_{\substack{2\mu \\ 2\lambda}} = \frac{.403\times10^{-5}}{.609\times10^{-2}\cdot.352\times10^{-2}} = 0.188$$ for the camera axis

$$\rho_{\substack{2\mu \\ 6\lambda}} = \frac{.279\times10^{-5}}{.609\times10^{-2}\cdot.344\times10^{-2}} = 0.133$$ between points for different parameters

$$\rho_{\substack{1\lambda \\ 6\lambda}} = \frac{.127\times10^{-4}}{.387\times10^{-2}\cdot.344\times10^{-2}} = 0.954$$ between points for the same parameter(λ)

$$\rho_{\substack{23\mu \\ 39\mu}} = \frac{.350\times10^{-4}}{.780\times10^{-2}\times.555\times10^{-2}} = 0.808$$ between points for the same parameter(μ).

μ SIGNIFIES SELENOGRAPHIC LATITUDE; λ, LONGITUDE.

Appendix H

Tabulation of Eigenvalues, Associated Rotation Angle, and Correlation Coefficient for Total Errors

Introduction:

With regard to the 2x2 covariance matrix of latitude and longitude error for a photo point (the camera axis, point 0, or the EVAL border points, 1, 6, 12, 17, 23, 28, 34, and 39), the eigenvalues and corresponding rotation angle are of interest, which depend upon the correlation between the latitude and longitude error. These quantities are listed by mission for the total errors below, where the eigenvalues λ_1 and λ_2 (reducing the original 2x2 covariance matrix to its diagonal canonical form) and the rotation angle β have the significance indicated in Figure 1, sketched for a bivariate normal distribution of latitude(μ) and longitude(λ) errors.

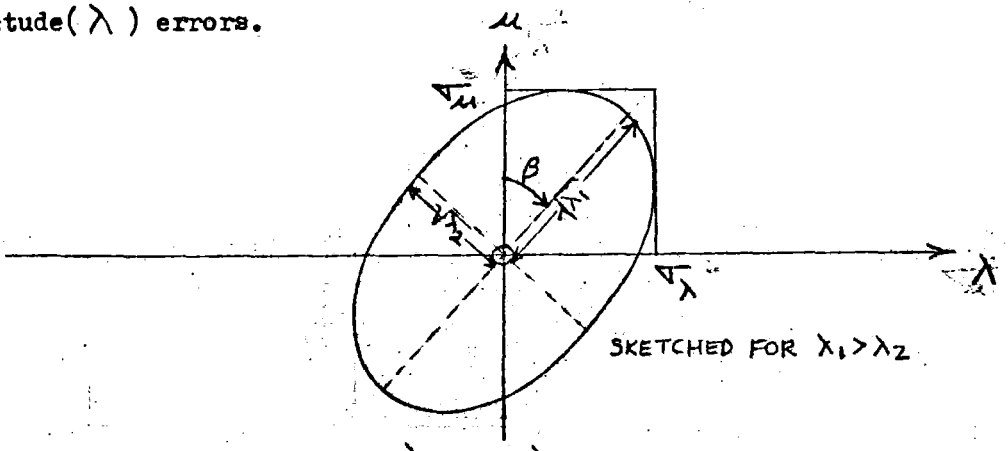

Figure 1, Eigenvalues λ_1 and λ_2 and Rotation Angle β for Covariance Matrix $\begin{bmatrix} \sigma_\mu^2 & \sigma_{\mu\lambda}^2 \\ \sigma_{\mu\lambda}^2 & \sigma_\lambda^2 \end{bmatrix}$ for a Given Point

Included in the tabulation is $\rho_{\mu\lambda}$, where

$$\rho_{\mu\lambda} = \frac{\sigma_{\mu\lambda}^2}{\sigma_\mu \sigma_\lambda} \quad ; \qquad (1)$$

the eigenvalues are

$$\lambda_1 = \tfrac{1}{2}\left[(\sigma_\mu^2+\sigma_\lambda^2) + \sqrt{(\sigma_\mu^2-\sigma_\lambda^2)^2+4(\sigma_{\mu\lambda}^2)^2}\right] \qquad (2)$$

and

$$\lambda_2 = \tfrac{1}{2}\left[(\sigma_\mu^2+\sigma_\lambda^2) - \sqrt{(\sigma_\mu^2-\sigma_\lambda^2)^2+4(\sigma_{\mu\lambda}^2)^2}\right] \qquad (3)$$

The rotation angle β is

$$\beta = \tfrac{1}{2}\tan^{-1}\left(\frac{2\,\sigma_{\mu\lambda}^2}{\sigma_\mu^2-\sigma_\lambda^2}\right) \qquad (4)$$

Appendix H, cont'd

Tabulation

The tabulation is given by mission on the following pages.

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION I

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
12	0	526 E-3	160 E-3	359.9	-.001	730 E-3	173 E-3	1.39	.038
	1	536 E-3	170 E-3	8.98	.184	858 E-3	216 E-3	349.6	-.524
	6	450 E-3	161 E-3	1.89	.049	487 E-3	236 E-3	358.8	-.053
	12	567 E-3	154 E-3	358.8	-.176	106 E-2	141 E-3	332.1	-.690
	17	585 E-3	153 E-3	359.2	-.149	111 E-2	162 E-3	351.5	-.310
	23	609 E-3	159 E-3	358.7	-.108	141 E-2	294 E-3	3.68	.110
	28	559 E-3	163 E-3	359.8	-.005	107 E-2	266 E-3	1.36	.036
	34	598 E-3	171 E-3	2.02	.159	161 E-2	275 E-3	3.98	.138
	39	569 E-3	170 E-3	2.90	.172	113 E-2	196 E-3	5.3	.553

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
28	0	.419 E-1	.727 E-2	5.84	.198	.519 E-1	.770 E-2	5.76	.214
	1	.510 E-1	.937 E-2	7.48	.426	.341 E-0	.271 E-1	52.5	.945
	6	.406 E-1	.747 E-2	7.10	.227	.420 E-1	.163 E-1	16.7	.262
	12	.457 E-1	.772 E-2	358.4	-.055	.169 E-0	.208 E-1	338.4	-.735
	17	.470 E-1	.757 E-2	359.2	-.028	.111 E+0	.126 E-1	351.9	-.375
	23	.489 E-1	.754 E-2	.105	.004	.174 E-0	.200 E-1	9.43	.369
	28	.435 E-1	.715 E-2	4.85	.171	.836 E-1	.123 E-1	2.05	.079
	34	.542 E-1	.921 E-2	11.0	.342	.257 E-0	.735 E-1	248.5	.425
	39	.525 E-1	.920 E-2	12.7	.389	.156 E-0	.174 E-1	18.8	.602

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
32	0	.791 E-3	.287 E-3	1.69	.312	.111 E-2	.303 E-3	1.69	.041
	1	.738 E-3	.260 E-3	20.1	.231	.101 E-2	.159 E-3	50.4	.120
	6	.697 E-3	.282 E-3	2.88	.047	.380 E-3	.337 E-3	9.1	.036
	12	.895 E-3	.281 E-3	344.4	-.302	.149 E-2	.195 E-3	345.8	-.168
	17	.970 E-3	.290 E-3	349.9	-.274	.218 E-2	.313 E-3	337.3	-.627
	23	.109 E-2	.304 E-3	349.5	-.228	.425 E-2	.600 E-3	355.6	-.173
	28	.875 E-3	.293 E-3	4.65	.020	.251 E-2	.478 E-3	4.21	.135
	34	.905 E-3	.270 E-3	16.4	.322	.274 E-2	.465 E-3	16.7	.465
	39	.825 E-3	.269 E-3	17.9	.326	.161 E-2	.269 E-3	26.9	.635

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
42	0	.110 E-2	.412 E-3	359.9	-.020	.152 E-2	.439 E-3	359.3	-.169
	1	.103 E-2	.392 E-3	14.8	.242	.117 E-2	.273 E-3	46.1	.621
	6	.962 E-3	.387 E-3	359.9	-.002	.502 E-3	.352 E-3	3.03	.019
	12	.114 E-2	.386 E-3	343.8	-.293	.140 E-2	.260 E-3	315.2	-.687
	17	.126 E-2	.415 E-3	345.6	-.272	.245 E-2	.467 E-3	335.0	-.579
	23	.143 E-2	.455 E-3	347.7	-.224	.589 E-2	.129 E-2	357.1	-.194
	28	.125 E-2	.444 E-3	3.82	.034	.389 E-2	.101 E-2	.945	.021
	34	.131 E-2	.452 E-3	12.0	.221	.469 E-2	.115 E-2	11.9	.293
	39	.117 E-2	.422 E-3	13.2	.231	.239 E-2	.506 E-3	23.5	.523

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
46	0	.109 E-3	.523 E-4	2.46	.082	.151 E-3	.541 E-4	2.66	.067
	1	.913 E-4	.471 E-4	2.00	.812	.114 E-3	.288 E-4	51.4	.588
	6	.950 E-4	.480 E-4	3.67	.044	.351 E-4	.434 E-4	32.7	.127
	12	.136 E-3	.519 E-4	350.9	-.154	.224 E-3	.379 E-4	339.7	-.695
	17	.148 E-3	.568 E-4	354	-.103	.327 E-3	.724 E-4	344.4	-.393
	23	.164 E-3	.636 E-4	357.4	-.044	.660 E-3	.172 E-3	4.45	.111
	28	.125 E-3	.579 E-4	5.47	.075	.361 E-3	.134 E-3	12.2	.209
	34	.115 E-3	.565 E-4	18.1	.209	.344 E-3	.140 E-3	18.9	.273
	39	.104 E-3	.517 E-4	18.7	.211	.192 E-3	.617 E-4	26.8	.439

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
59	0	.309 E-4	.116 E-4	358.9	-.020	.434 E-4	.123 E-4	5.65	.013
	1	.373 E-4	.124 E-4	12.1	.227	.976 E-4	.176 E-4	73.9	.694
	6	.297 E-4	.121 E-4	359.4	-.010	.388 E-4	.301 E-4	359.4	-.095
	12	.389 E-4	.110 E-4	353.1	-.158	.111 E-3	.111 E-4	339.8	-.741
	17	.390 E-4	.115 E-4	352.6	-.077	.901 E-4	.130 E-4	351.4	-.102
	23	.394 E-4	.127 E-4	357.1	-.008	.105 E-3	.357 E-4	5.7	.104
	28	.322 E-4	.120 E-4	358.8	-.042	.588 E-4	.368 E-4	354.5	-.045
	34	.406 E-4	.121 E-4	9.11	.091	.126 E-3	.248 E-4	348.3	-.301
	39	.389 E-4	.120 E-4	2.55	.160	.927 E-4	.134 E-4	11.3	.398

$\lambda_1, \lambda_2, \beta, \rho$ FOR TOTAL ERRORS — MISSION I

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
75	0	.377 E-4	.140 E-4	63.1	.01	.530 E-4	.149 E-4	R1.4	.057
	1	.433 E-4	.147 E-4	17.2	.304	.105 E-3	.144 E-4	R8.7	.756
	6	.350 E-4	.145 E-4	2.6	.020	.404 E-4	.277 E-4	R16.8	.105
	12	.469 E-4	.130 E-4	35.3	2.41	.122 E-3	.100 E-4	330.6	8.08
	17	.477 E-4	.136 E-4	35.6	1.46	.108 E-3	.159 E-4	32.1	2.90
	23	.415 E-4	.150 E-4	35.2	.069	.136 E-3	.460 E-4	11.2	R6.1
	28	.405 E-4	.145 E-4	43.2	.008	.167 E-4	.400 E-4	1.30	.018
	34	.489 E-4	.155 E-4	9.87	R.07	.153 E-3	.354 E-4	35.7	.024
	39	.461 E-4	.146 E-4	12.9	R5.7	.109 E-3	.162 E-4	R.0	.552

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
84	0	.102 E-3	.369 E-4	R.9	.162	.140 E-3	.311 E-4	6.12	.154
	1	.842 E-4	.307 E-4	R0.7	.329	.992 E-4	.167 E-4	R7.5	.710
	6	.888 E-4	.326 E-4	R8.5	.152	.463 E-4	.313 E-4	32.8	.049
	12	.128 E-3	.390 E-4	35.5	.077	.205 E-3	.332 E-4	32.3	.688
	17	.140 E-3	.431 E-4	35.9	.020	.310 E-3	.620 E-4	31.4	.353
	23	.156 E-3	.494 E-4	1.9.1	.041	.645 E-3	.156 E-3	6.64	.174
	28	.118 E-3	.424 E-4	9.60	.173	.342 E-3	.116 E-3	14.7	.266
	34	.106 E-3	.401 E-4	1.96	.305	.311 E-3	.121 E-3	R0.3	.303
	39	.956 E-4	.353 E-4	19.9	.816	.173 E-3	.451 E-4	R6.6	.592

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
92	0	.506 E-4	.235 E-4	15.9	.148	.65 E-2	.251 E-2	52.7	.130
	1	.516 E-4	.293 E-4	R.12	.080	.115 E-3	.290 E-4	29.0	.578
	6	.472 E-4	.240 E-4	13.9	.185	.568 E-4	.287 E-4	R9.3	.253
	12	.620 E-4	.174 E-4	33.1	3.90	.742 E-3	.126 E-4	35.0	R.32
	17	.630 E-4	.208 E-4	31.1	.336	.127 E-3	.235 E-4	32.9	.997
	23	.649 E-4	.230 E-4	19.2	.272	.155 E-3	.603 E-4	2.41	.057
	28	.542 E-4	.239 E-4	16.7	.145	.111 E-3	.495 E-4	35.4	.066
	34	.600 E-4	.221 E-4	R.18	.030	.177 E-3	.511 E-4	1.59	.037
	39	.516 E-4	.223 E-4	9.51	.054	.122 E-3	.331 E-4	19.4	.398

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
103	0	.123 E-3	.381 E-4	12.4	.291	.149 E-3	.900 E-4	10.2	.238
	1	.132 E-3	.377 E-4	18.6	.407	.190 E-3	.303 E-4	6.0	.707
	6	.117 E-3	.363 E-4	14.3	R5.3	.104 E-3	.465 E-4	33.3	.355
	12	.126 E-3	.446 E-4	35.8	.064	.188 E-3	.681 E-4	27.1	.435
	17	.134 E-3	.449 E-4	31.02	.080	.249 E-3	.606 E-4	19.3	.268
	23	.144 E-3	.467 E-4	31.85	.100	.448 E-3	.117 E-3	6.56	.159
	28	.130 E-3	.409 E-4	11.0	.221	.260 E-3	.968 E-4	8.91	.156
	34	.143 E-3	.396 E-4	14.7	.320	.305 E-3	.105 E-3	5.88	.113
	39	.138 E-3	.365 E-4	16.4	.361	.222 E-3	.460 E-4	18.0	.455

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
116	0	.521 E-1	.910 E-2	9.93	.167	.641 E-1	.969 E-2	9.89	.181
	1	.549 E-1	.108 E-1	11.1	.323	.147 E-0	.241 E-1	11.8	.717
	6	.491 E-1	.893 E-2	8.91	.177	.132 E-1	.140 E-1	7.68	.157
	12	.635 E-1	.101 E-1	39.8	.016	.255 E-0	.252 E-1	39.0	R.48
	17	.665 E-1	.103 E-1	2.56	.032	.210 E-0	.208 E-1	36.8	.158
	23	.710 E-1	.108 E-1	R.12	.091	.451 E+1	.703 E-1	11.0	.969
	28	.559 E-1	.951 E-2	11.2	.763	.131 E-0	.279 E-1	5.18	.233
	34	.612 E-1	.116 E-1	R3.2	.257	.424 E-0	.689 E-1	31.7	.655
	39	.581 E-1	.111 E-1	9.57	.290	.142 E-0	.234 E-1	3.1	.414

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
125	0	.345 E-4	.102 E-4	R.14	.048	.485 E-4	.109 E-4	3.08	.087
	1	.399 E-4	.105 E-4	R.6	.295	.951 E-4	.914 E-5	50.4	.820
	6	.314 E-4	.104 E-4	R.92	.059	.337 E-4	.207 E-4	R89.0	.114
	12	.439 E-4	.940 E-5	30.8	2.55	.113 E-3	.672 E-5	32.9.1	.267
	17	.447 E-4	.102 E-4	32.0	.165	.104 E-3	.134 E-5	35.6	.361
	23	.472 E-4	.117 E-4	35.8	.069	.139 E-3	.460 E-4	11.7	.224
	28	.379 E-4	.109 E-4	1.32	.042	.891 E-4	.377 E-4	2.84	.644
	34	.457 E-4	.113 E-4	11.6	.246	.150 E-3	.360 E-4	R.10	.057
	39	.426 E-4	.106 E-4	14.5	.342	.102 E-3	.139 E-4	R0.2	.604

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION I

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
135	0	.559 E-4	.304 E-4	19.9	-.193	.734 E-4	.322 E-4	43.1	-.183
	1	.457 E-4	.245 E-4	21.9	-.293	.694 E-4	.127 E-4	56.4	-.656
	6	.487 E-4	.287 E-4	19.6	-.166	.393 E-4	.265 E-4	28.9	-.121
	12	.785 E-4	.335 E-4	25.3	-.012	.161 E-3	.305 E-4	82.0	-.635
	17	.893 E-4	.363 E-4	25.5	-.077	.195 E-3	.467 E-4	52.3	-.204
	23	.924 E-4	.373 E-4	24.0	-.147	.314 E-3	.919 E-4	44.4	-.325
	28	.610 E-4	.323 E-4	20.8	-.221	.167 E-3	.721 E-4	35.5	-.318
	34	.599 E-4	.296 E-4	24.5	-.282	.138 E-3	.812 E-4	23.8	-.194
	39	.504 E-4	.270 E-4	25.1	-.288	.866 E-4	.329 E-4	29.1	-.410

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
137	0	.283 E-3	.494 E-4	27.5	-.230	.258 E-3	.677 E-4	30.8	-.221
	1	.206 E-3	.369 E-4	27.4	-.082	.109 E-3	.228 E-4	37.4	-.244
	6	.217 E-3	.409 E-4	27.3	-.207	.103 E-3	.183 E-4	35.3	-.157
	12	.257 E-3	.585 E-4	27.6	-.435	.156 E-3	.700 E-4	57.3	-.351
	17	.294 E-3	.662 E-4	27.7	-.439	.382 E-3	.130 E-3	56.6	-.461
	23	.350 E-3	.774 E-4	27.8	-.442	.245 E-2	.512 E-3	60.1	-.599
	28	.299 E-3	.594 E-4	28.6	-.252	.120 E-2	.286 E-3	79.1	-.280
	34	.274 E-3	.525 E-4	27.6	-.082	.928 E-3	.244 E-3	78.9	-.279
	39	.239 E-3	.447 E-4	27.5	-.083	.273 E-3	.781 E-4	78.5	-.253

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
139	0	.417 E-4	.136 E-4	9.16	.125	.543 E-4	.192 E-4	5.13	.130
	1	.302 E-4	.121 E-4	2.23	.315	.581 E-4	.795 E-5	55.7	.136
	6	.367 E-4	.133 E-4	3.31	.061	.389 E-4	.172 E-4	30.4	-.353
	12	.685 E-4	.145 E-4	3.54	-.174	.170 E-3	.141 E-4	3.29	-.814
	17	.715 E-4	.154 E-4	3.59	-.515	.175 E-3	.220 E-4	3.09	-.351
	23	.759 E-4	.169 E-4	2.49	-.611	.264 E-3	.479 E-4	13.4	-.368
	28	.475 E-4	.145 E-4	6.89	.188	.116 E-3	.385 E-4	21.9	-.371
	34	.365 E-4	.133 E-4	20.8	.330	.924 E-4	.447 E-4	16.9	-.201
	39	.339 E-4	.184 E-4	21.1	.328	.616 E-4	.147 E-4	26.1	-.524

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
150	0	1.000 E-4	.496 E-4	64.4	.089	.101 E-3	.662 E-4	60.9	-.066
	1	.991 E-4	.380 E-4	62.3	.132	.129 E-3	.269 E-4	73.0	-.436
	6	.970 E-4	.435 E-4	60.1	.563	.105 E-3	.274 E-4	77.4	-.046
	12	.101 E-3	.692 E-4	27.8	-.031	.178 E-3	.634 E-4	30.3	-.462
	17	.103 E-3	.749 E-4	29.2	-.451	.175 E-3	.110 E-3	33.5	-.163
	23	.108 E-3	.813 E-4	30.1	-.045	.311 E-3	.168 E-3	19.8	-.195
	28	.104 E-3	.562 E-4	82.2	.845	.183 E-3	.327 E-3	53.8	-.172
	34	.105 E-3	.477 E-4	81.3	.121	.171 E-3	.139 E-3	54.1	.080
	39	.102 E-3	.431 E-4	81.1	.126	.125 E-3	.699 E-4	54.1	-.226

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
154	0	.380 E-4	.146 E-4	39.6	-.158	.514 E-4	.154 E-4	53.2	-.150
	1	.472 E-4	.155 E-4	41.4	-.093	.705 E-4	.146 E-4	35.4	-.737
	6	.347 E-4	.139 E-4	32.6	-.120	.306 E-4	.209 E-4	64.9	-.154
	12	.401 E-4	.128 E-4	33.4	-.369	.184 E-4	.842 E-5	21.3	-.019
	17	.427 E-4	.142 E-4	34.2	-.319	.892 E-4	.172 E-4	33.0	-.538
	23	.462 E-4	.166 E-4	34.5	-.258	.140 E-3	.575 E-4	35.5	-.024
	28	.414 E-4	.162 E-4	34.3	-.173	.102 E-3	.511 E-4	34.6	-.124
	34	.548 E-4	.184 E-4	37.5	-.050	.184 E-3	.574 E-4	34.5	-.216
	39	.511 E-4	.168 E-4	34.7	.002	.121 E-3	.255 E-4	34.0	-.215

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
164	0	.339 E-4	.178 E-4	39.2	-.260	.367 E-4	.226 E-4	30.8	-.215
	1	.335 E-4	.256 E-4	29.2	-.087	.921 E-4	.328 E-4	55.8	-.448
	6	.345 E-4	.178 E-4	29.9	-.252	.623 E-4	.239 E-4	36.1	-.256
	12	.386 E-4	.215 E-4	31.2	-.289	.111 E-3	.226 E-4	32.6	-.628
	17	.366 E-4	.227 E-4	31.3	-.252	.229 E-4	.303 E-4	35.6	-.129
	23	.349 E-4	.245 E-4	30.3	-.171	.832 E-9	.399 E-4	76.3	-.351
	28	.339 E-4	.181 E-4	29.8.0	-.254	.546 E-4	.294 E-4	29.6	-.203
	34	.350 E-4	.239 E-4	30.9	-.184	.987 E-4	.281 E-4	33.4	-.433
	39	.337 E-4	.294 E-4	30.5	-.138	.678 E-4	.324 E-4	30.70	-.049

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION I

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
173	0	.831 E-11	.293 E-4	-35.4	-.333	.141 E-3	.338 E-4	-34.4	-.326	12	.164 E-3	.223 E-4	-36.2	-.604	.654 E-3	.109 E-4	-34.2	-.192	28	.692 E-4	.279 E-4	-34.2	-.132	.115 E-3	.321 E-4	-35.2	-.280
	1	.504 E-4	.441 E-4	-36.5	-.054	.162 E-3	.249 E-4	-34.2	-.197	17	.115 E-3	.201 E-4	-36.3	-.631	.744 E-3	.217 E-4	-34.9	-.191	34	.529 E-4	.321 E-4	-34.8	-.132	.109 E-3	.194 E-4	-35.2	-.252
	6	.849 E-4	.315 E-4	-35.9	-.422	.171 E-3	.311 E-4	-34.2	-.326	23	.153 E-3	.211 E-4	-34.1	-.352	.732 E-3	.227 E-4	-34.3	-.193	39	.497 E-4	.411 E-4	-36.2	-.093	.130 E-3	.259 E-4	-35.2	-.350

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
174	0	.917 E-4	.824 E-4	-36.6	-.028	.123 E-3	.959 E-4	-37.2	-.001	12	.122 E-3	.784 E-4	-36.4	-.122	.204 E-3	.514 E-4	-32.1	-.382	28	.104 E-3	.923 E-4	-36.8	-.089	.134 E-3	.444 E-4	-34.0	-.242
	1	.805 E-4	.692 E-4	-36.6	-.088	.974 E-4	.433 E-4	-34.1	-.212	17	.134 E-3	.861 E-4	-36.2	-.103	.284 E-3	.109 E-3	-33.1	-.261	34	.741 E-4	.841 E-4	-37.3	-.040	.235 E-3	.177 E-3	-36.1	-.149
	6	.932 E-4	.749 E-4	-36.5	-.053	.766 E-4	.337 E-4	-34.2	-.212	23	.144 E-3	.927 E-4	-36.3	-.120	.159 E-3	.204 E-3	-40.1	-.187	39	.343 E-4	.779 E-4	-37.5	-.045	.174 E-3	.921 E-4	-36.3	-.202

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
175	0	.240 E-3	.191 E-4	-30.4	-.393	.220 E-3	.215 E-4	-34.5	-.329	12	.123 E-3	.151 E-4	-32.5	-.663	.407 E-3	.124 E-4	-32.3	-.936	28	.712 E-4	.180 E-4	-34.5	-.338	.122 E-3	.226 E-4	-32.7	-.260
	1	.403 E-4	.295 E-4	-34.6	-.098	.109 E-3	.227 E-4	-32.1	-.452	17	.120 E-3	.153 E-4	-34.1	-.600	.302 E-3	.167 E-4	-32.7	-.762	34	.444 E-4	.235 E-4	-35.0	-.011	.898 E-4	.228 E-4	-36.8	-.319
	6	.462 E-4	.204 E-4	-34.5	-.432	.113 E-3	.228 E-4	-30.6	-.616	23	.119 E-3	.157 E-4	-34.3	-.503	.310 E-3	.296 E-4	-38.2	-.191	39	.421 E-4	.260 E-4	-35.9	-.052	.700 E-4	.218 E-4	-30.6	-.476

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
179	0	.311 E-4	.216 E-4	-35.3	-.164	.361 E-4	.261 E-4	-32.7	-.196	12	.324 E-4	.277 E-4	-27.6	-.065	.101 E-3	.312 E-4	-32.8	-.484	28	.312 E-4	.221 E-4	-36.1	-.159	.518 E-4	.401 E-4	-30.1	-.099
	1	.394 E-4	.213 E-4	-35.2	-.298	.109 E-3	.201 E-4	-31.1	-.669	17	.337 E-4	.264 E-4	-34.0	-.119	.745 E-4	.296 E-4	-33.9	-.063	34	.368 E-4	.244 E-4	-34.2	-.190	.102 E-3	.367 E-4	-33.1	-.277
	6	.318 E-4	.212 E-4	-36.1	-.172	.594 E-4	.224 E-4	-36.8	-.058	23	.355 E-4	.247 E-4	-34.2	-.176	.979 E-4	.341 E-4	-32.0	-.482	39	.378 E-4	.228 E-4	-34.5	-.245	.804 E-4	.261 E-4	-32.0	-.315

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
191	0	.566 E-4	.224 E-4	-39.6	-.410	.609 E-4	.288 E-4	-38.4	-.352	12	.623 E-4	.231 E-4	-35.9	-.459	.132 E-3	.189 E-4	-32.8	-.731	28	.562 E-4	.235 E-4	-36.6	-.409	.857 E-4	.490 E-4	-33.2	-.261
	1	.582 E-4	.311 E-4	-36.0	-.288	.961 E-4	.452 E-4	-41.1	-.311	17	.611 E-4	.261 E-4	-36.3	-.417	.100 E-3	.360 E-4	-38.9	-.337	34	.575 E-4	.302 E-4	-36.9	-.310	.135 E-3	.477 E-4	-35.5	-.348
	6	.551 E-4	.218 E-4	-38.0	-.423	.747 E-4	.237 E-4	-39.6	-.411	23	.603 E-4	.279 E-4	-36.3	-.367	.102 E-3	.758 E-4	-39.1	-.093	39	.552 E-4	.304 E-4	-34.5	-.286	.885 E-4	.478 E-4	-35.9	-.001

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
207	0	.794 E-4	.241 E-4	-39.6	-.477	.823 E-4	.323 E-4	-38.2	-.411	12	.848 E-4	.267 E-4	-39.3	-.496	.154 E-3	.276 E-4	-37.9	-.694	28	.799 E-4	.252 E-4	-39.1	-.468	.104 E-3	.496 E-4	-39.4	-.327
	1	.776 E-4	.326 E-4	-39.2	-.393	.114 E-3	.667 E-4	-35.0	-.175	17	.835 E-4	.286 E-4	-39.3	-.462	.112 E-3	.493 E-4	-37.4	-.358	34	.796 E-4	.328 E-4	-39.2	-.380	.144 E-3	.576 E-4	-38.6	-.386
	6	.795 E-4	.234 E-4	-38.1	-.481	.103 E-3	.252 E-4	-39.2	-.470	23	.823 E-4	.310 E-4	-39.5	-.423	.101 E-3	.967 E-4	-43.7	-.017	39	.782 E-4	.327 E-4	-39.0	-.363	.924 E-4	.677 E-4	-38.2	-.103

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION II

FRAME 22

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	488 E-4	121 E-4	6.38	.765	.604 E-4	.124 E-4	6.39	.190
1	546 E-4	132 E-4	22.9	.976	.119 E-3	.176 E-4	54.0	.725
6	459 E-4	130 E-4	2.58	.765	.460 E-4	.316 E-4	2.59	.639
12	579 E-4	124 E-4	5.13	.219	.133 E-3	.169 E-4	7.95	.759
17	599 E-4	119 E-4	3.51	.151	.120 E-3	.181 E-4	3.41	.962
23	628 E-4	119 E-4	3.51	.068	.157 E-3	.366 E-4	5.13	.140
28	525 E-4	119 E-4	5.11	.164	.106 E-3	.273 E-4	6.69	.167
34	607 E-4	119 E-4	12.0	.951	.159 E-3	.323 E-4	11.3	.321
39	577 E-4	122 E-4	8.11	.969	.117 E-3	.152 E-4	26.1	.691

FRAME 26

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	480 E-4	192 E-4	3.51.2	-.0016	.565 E-4	.196 E-4	3.59.1	-.018
1	443 E-4	226 E-4	36.8	.315	.131 E-3	.241 E-4	15.9	.421
6	433 E-4	224 E-4	3.53.2	-.019	.780 E-4	.237 E-4	3.59.1	-.390
12	768 E-4	170 E-4	3.54	-.463	.225 E-3	.326 E-4	3.56	-.746
17	776 E-4	164 E-4	3.51.6	-.901	.181 E-3	.237 E-4	3.51.8	-.683
23	798 E-4	159 E-4	3.49.1	-.315	.228 E-3	.365 E-4	3.58.8	-.049
28	534 E-4	169 E-4	3.51.1	-.007	.121 E-3	.211 E-4	10.2	.326
34	509 E-4	178 E-4	26.5	.902	.191 E-3	.270 E-4	21.4	.602
39	475 E-4	197 E-4	3.00	.376	.101 E-3	.186 E-4	13.0	.688

FRAME 33

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	562 E-1	118 E-1	3.79	.113	.697 E-1	.121 E-1	3.69	.129
1	662 E-1	149 E-1	11.8	.310	.402 E-0	.390 E-1	50.8	.817
6	593 E-1	121 E-1	7.87	.138	.558 E-1	.240 E-1	13.3	.191
12	692 E-1	127 E-1	3.51.3	.083	.297 E-0	.328 E-1	28.9	.769
17	661 E-1	126 E-1	3.58.3	.059	.175 E-0	.212 E-1	3.51.6	.393
23	688 E-1	127 E-1	3.59.4	.018	.362 E-0	.420 E-1	17.4	.596
28	586 E-1	119 E-1	3.00	.092	.114 E-0	.281 E-1	1.39	.043
34	705 E-1	150 E-1	2.72	.222	.422 E-0	.611 E-1	33.51	.691
39	683 E-1	148 E-1	9.53	.265	.196 E-0	.310 E-1	13.9	.443

FRAME 34

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	851 E-1	135 E-1	4.25	.317	.104 E+0	.138 E-1	9.19	.351
1	544 E-1	129 E-1	15.2	.370	.730 E-1	.273 E-1	48.3	.453
6	775 E-1	135 E-1	1.67	.253	.939 E-1	.272 E-1	3.46.1	.293
12	271 E-0	222 E-1	2.70	.149	ND			
17	271 E-0	217 E-1	6.06	.323	ND			
23	282 E-0	217 E-1	10.00	.495	ND			
28	948 E-1	138 E-1	11.00	.387	.270 E-0	.250 E-1	27.6	.775
34	594 E-1	125 E-1	16.6	.426	.110 E+0	.258 E-1	21.2	.471
39	569 E-1	125 E-1	6.00	.402	.754 E-1	.159 E-1	26.8	.569

FRAME 38

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	.260 E-4	.842 E-5	4.06	.0824	.366 E-4	.869 E-5	8.920	.1326
1	.516 E-4	.853 E-5	21.7	.435	.884 E-4	.683 E-5	51.39	.8508
6	.287 E-4	.882 E-5	5.16	.0889	.325 E-4	.161 E-4	2.782	.1008
12	.341 E-4	.776 E-5	5.51	.0333	.993 E-4	.542 E-5	32.92	.8778
17	.352 E-4	.827 E-5	5.53	.0218	.857 E-4	.103 E-4	32.24	.8538
23	.367 E-4	.842 E-5	5.54	.0161	.113 E-3	.364 E-4	6.85	.3148
28	.284 E-4	.881 E-5	5.126	.0882	.661 E-4	.822 E-4	5.480	.0692
34	.357 E-4	.911 E-5	13.19	.3119	.119 E-3	.299 E-4	3.989	.0049
39	.337 E-4	.853 E-5	16.13	.3168	.944 E-4	.109 E-4	20.30	.6982

FRAME 62

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	276 E-4	103 E-4	2.63	.0470	.388 E-4	.106 E-4	3.77	.0908
1	328 E-4	971 E-5	3.12	.0497	.893 E-4	.827 E-5	62.8	.772
6	228 E-4	103 E-4	4.44	.0621	.311 E-4	.459 E-5	27.0	.2260
12	371 E-4	.899 E-5	3.60.1	.0431	.103 E-3	.938 E-5	3.15.6	.0833
17	399 E-4	.102 E-4	3.45.3	.0340	.102 E-3	.175 E-4	3.38.0	.0570
23	.483 E-4	.123 E-4	3.49.6	.0237	.169 E-3	.567 E-4	3.51.5	.0490
28	329 E-4	112 E-4	1.85	.0364	.111 E-3	.392 E-4	4.63	.0877
34	412 E-4	122 E-4	2.17	.0406	.168 E-3	.514 E-4	16.5	.3249
39	370 E-4	108 E-4	2.54	.0452	.100 E-3	.190 E-4	33.4	.6499

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION II

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
75	0	.707 E-1	.144 E-1	359.2	-.025	.863 E-1	.146 E-1	359.1	-.032
	1	.153 E-0	.244 E-1	6.58	.296	ND			
	6	.713 E-1	.151 E-1	2.51	.018	.104 E-0	.285 E-1	3.2	.538
	12	.529 E-1	.127 E-1	353.5	-.171	.850 E-1	.251 E-1	327.1	-.509
	17	.549 E-1	.125 E-1	351.9	-.196	.799 E-1	.154 E-1	343.0	-.457
	23	.577 E-1	.125 E-1	352.1	-.215	.123 E-0	.264 E-1	349.8	-.282
	28	.711 E-1	.141 E-1	358.3	-.116	.151 E-0	.249 E-0	339.2	-.564
	34	.161 E-0	.245 E-1	358.8	-.044	ND			
	39	.155 E-0	.243 E-1	3.2	.119	ND			

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
79	0	.262 E-4	.174 E-4	357.8	-.015	.364 E-4	.177 E-4	2.030	0.259
	1	.325 E-4	.178 E-4	22.8	.212	.948 E-4	.169 E-4	50.80	.913
	6	.249 E-4	.181 E-4	357.1	-.029	.444 E-4	.239 E-4	2.840	.1113
	12	.352 E-4	.164 E-4	3.718	-.160	.106 E-3	.140 E-4	335.96	.1127
	17	.351 E-4	.169 E-4	353.2	-.087	.830 E-4	.180 E-4	355.77	.1238
	23	.354 E-4	.179 E-4	359.2	-.009	.100 E-3	.367 E-4	2.750	2.920
	28	.276 E-4	.175 E-4	358.4	-.025	.517 E-4	.394 E-4	.49	.0023
	34	.346 E-4	.178 E-4	9.27	.107	.108 E-3	.298 E-4	358.9	-.210
	39	.334 E-4	.176 E-4	1.9	.159	.809 E-4	.184 E-4	15.8	.391

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
87	0	.268 E-4	.199 E-4	359.3	-.0485	.357 E-4	.205 E-4	359.5	-.0094
	1	.328 E-4	.209 E-4	2.7	.160	.97 E-4	.207 E-4	0.32	.674
	6	.258 E-4	.207 E-4	348.2	-.0436	.489 E-4	.263 E-4	2.16	-.122
	12	.360 E-4	.195 E-4	3.47	-.162	.109 E-3	.169 E-4	331.2	.1674
	17	.355 E-4	.194 E-4	0.9	-.089	.832 E-4	.203 E-4	2.43	.0952
	23	.354 E-4	.205 E-4	1.22	-.022	.980 E-4	.372 E-4	2.02	.1178
	28	.271 E-4	.209 E-4	352.6	-.042	.490 E-4	.416 E-4	352.2	-.022
	34	.347 E-4	.205 E-4	4.42	0.588	.107 E-3	.382 E-4	346.4	-.263
	39	.335 E-4	.205 E-4	13.11	.109	.804 E-4	.221 E-4	4.31	-.327

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
93	0	.702 E-2	.737 E-4	11.9	.82	1.493 E-2	.760 E-4	12.0	.8489
	1	.609 E-3	.454 E-4	12.3	.661	12.97 E-3	.616 E-4	356.3	-.113
	6	.314 E-2	.684 E-4	9.47	.731	.221 E-2	.746 E-4	352.3	-.571
	12			ND				ND	
	17			ND				ND	
	23			ND				ND	
	28	.531 E-2	.804 E-4	14.2	.898	.199 E-1	.111 E-3	3.01	.9867
	34	.102 E-2	.43 E-4	12.8	.804	.702 E-3	.271 E-4	358.5	-.922
	39	.965 E-3	.44 E-4	15.3	.751	.419 E-3	.364 E-4	13.5	.751

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
99	0	.234 E-4	.192 E-4	344.8	-.0099	.324 E-4	.199 E-4	359.7	-.0021
	1	.299 E-4	.184 E-4	39.3	.232	.899 E-4	.113 E-4	57.8	.743
	6	.214 E-4	.193 E-4	325.9	-.0472	.482 E-4	.117 E-4	278.6	-2.02
	12	.333 E-4	.167 E-4	335.5	-.257	.994 E-4	.108 E-4	323.3	-.791
	17	.336 E-4	.181 E-4	341.6	-.185	.815 E-4	.209 E-4	342.2	-.303
	23	.346 E-4	.201 E-4	348.6	-.106	.109 E-3	.493 E-4	16.6	.217
	28	.259 E-4	.188 E-4	358.2	-.0459	.636 E-4	.434 E-4	2.48	.0165
	34	.227 E-4	.205 E-4	19.7	.142	.114 E-3	.427 E-4	359.8	-.0045
	39	.910 E-4	.195 E-4	26.9	.186	.794 E-4	.223 E-4	24.4	.454

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
116	0	.261 E-4	.142 E-4	2.21	.0628	.286 E-4	.143 E-4	1.82	.0439
	1	.324 E-4	.143 E-4	2.16	.248	.553 E-4	.144 E-4	0.49	.1231
	6	.241 E-4	.153 E-4	.660	.0527	.425 E-4	.217 E-4	1.82	.0455
	12	.355 E-4	.173 E-4	2.22	-.129	.107 E-3	.113 E-4	2.19	-.269
	17	.351 E-4	.32 E-4	2.54	-.091	.134 E-4	.114 E-4	2.52	-.158
	23	.331 E-4	.174 E-4	2.39	-.082	.101 E-3	.349 E-4	2.52	-.283
	28	.271 E-4	.142 E-4	1.42	.0853	.533 E-4	.306 E-4	2.20	.0151
	34	.341 E-4	.145 E-4	1.91	.154	.110 E-3	.227 E-4	2.52	-.155
	39	.331 E-4	.144 E-4	1.45	2.10	.132 E-4	.154 E-4	1.65	.459

$\lambda_1, \lambda_2, \beta, \rho$ FOR TOTAL ERRORS — MISSION II

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
124	0	.269 E-4	.164 E-4	257.8	-.023	.371 E-4	.168 E-4	168	-.034
	1	.339 E-4	.172 E-4	21.1	.217	.977 E-4	.177 E-4	49.7	.685
	6	.256 E-4	.173 E-4	357.5	-.048	.454 E-4	.256 E-4	351.5	-.115
	12	.360 E-4	.155 E-4	349.2	-.168	.111 E-3	.135 E-4	331.7	-.718
	17	.358 E-4	.159 E-4	350.1	-.022	.853 E-4	.167 E-4	351.7	-.121
	23	.360 E-4	.166 E-4	359.2	-.011	.100 E-3	.350 E-4	22.3	.403
	28	.280 E-4	.165 E-4	2.84	-.015	.514 E-4	.378 E-4	5.21	-.001
	34	.357 E-4	.166 E-4	0.51	.110	.109 E-3	.274 E-4	2.96	-.155
	39	.339 E-4	.163 E-4	1.37	.164	.822 E-4	.173 E-4	5.27	-.231

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
132	0	.275 E-4	.199 E-4	350.0	-.0548	.382 E-4	.206 E-4	358.9	-.012
	1	.335 E-4	.213 E-4	21.1	.151	.100 E-3	.225 E-4	49.6	.629
	6	.266 E-4	.208 E-4	347.4	-.0619	.503 E-4	.286 E-4	283.0	-.124
	12	.371 E-4	.189 E-4	345.2	-.167	.114 E-3	.176 E-4	331.7	-.669
	17	.364 E-4	.194 E-4	350.1	-.101	.858 E-4	.203 E-4	356.6	-.0972
	23	.361 E-4	.205 E-4	357.3	-.0263	.988 E-4	.366 E-4	30.5	.412
	28	.264 E-4	.200 E-4	351.7	-.0504	.491 E-4	.413 E-4	349.0	-.0392
	34	.353 E-4	.205 E-4	5.22	.0491	.109 E-3	.291 E-4	347.5	-.298
	39	.342 E-4	.207 E-4	11.7	.100	.829 E-4	.212 E-4	13.4	.315

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
137	0	.590 E-4	.135 E-4	6.98	.241	.683 E-4	.139 E-4	8.30	.244
	1	.628 E-4	.149 E-4	21.8	.475	.103 E-3	.372 E-4	56.6	.440
	6	.540 E-4	.133 E-4	10.4	.259	.390 E-4	.320 E-4	36.3	.0931
	12	.643 E-4	.178 E-4	356.1	-.0938	.115 E-3	.433 E-4	318.8	-.448
	17	.686 E-4	.180 E-4	357.6	-.0611	.127 E-3	.356 E-4	341.1	-.384
	23	.745 E-4	.192 E-4	359.0	-.0242	.215 E-3	.686 E-4	355.2	-.101
	28	.648 E-4	.147 E-4	1.92	.217	.155 E-3	.435 E-4	6.42	.149
	34	.732 E-4	.165 E-4	18.5	.441	.214 E-3	.615 E-4	20.7	.403
	39	.681 E-4	.153 E-4	19.8	.462	.130 E-3	.309 E-4	32.4	.576

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
141	0	.305 E-4	.204 E-4	29.9	.172	.402 E-4	.216 E-4	17.9	.182
	1	.398 E-4	.174 E-4	39.7	.394	.104 E-3	.119 E-4	53.9	.780
	6	.295 E-4	.203 E-4	27.6	.179	.489 E-4	.214 E-4	28.6	.0213
	12	.360 E-4	.228 E-4	357.9	-.0172	.105 E-3	.202 E-4	328.1	-.638
	17	.371 E-4	.226 E-4	5.03	.0438	.867 E-4	.245 E-4	355.5	-.104
	23	.391 E-4	.228 E-4	11.6	.107	.113 E-3	.431 E-4	24.5	.353
	28	.322 E-4	.210 E-4	25.8	.167	.640 E-4	.432 E-4	16.9	.110
	34	.409 E-4	.198 E-4	29.05	.294	.116 E-3	.403 E-4	360.0	-.0008
	39	.401 E-4	.185 E-4	32.9	.339	.894 E-4	.206 E-4	24.2	.514

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
162	0	.629 E-2	.848 E-4	3.85	-.211	.780 E-2	.864 E-4	3.45	-.211
	1	ND		ND			ND		
	6	.725 E-2	.937 E-4	1.96	.216	.724 E-2	.127 E-3	1.88	.915
	12	.113 E-2	.982 E-4	351.9	-.173	.338 E-3	.726 E-4	12.7	.392
	17	.120 E-2	.965 E-4	353.3	-.368	.451 E-3	.926 E-4	3.99.4	-.793
	23	.130 E-2	.948 E-4	351.4	-.542	.880 E-3	.269 E-4	331.6	-.918
	28	.559 E-2	.775 E-4	3.55.9	-.536	.128 E-1	.830 E-4	3.9.2	-.971
	34		ND				ND		
	39								

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
166	0	.319 E-4	.186 E-4	3.35	.0318	.445 E-4	.189 E-4	4.44	.0619
	1	.387 E-4	.186 E-4	23.4	.264	.106 E-3	.178 E-4	49.7	.707
	6	.302 E-4	.195 E-4	4.58	.0353	.475 E-4	.289 E-4	2.793	.0796
	12	.412 E-4	.178 E-4	350.4	-.141	.119 E-3	.157 E-4	331.3	-.709
	17	.414 E-4	.181 E-4	355.2	-.0716	.961 E-4	.189 E-4	355.1	-.152
	23	.422 E-4	.189 E-4	2.58	.003	.114 E-3	.994 E-4	22.7	.368
	28	.336 E-4	.186 E-4	3.21	-.0336	.639 E-4	.400 E-4	4.67	.0384
	34	.413 E-4	.186 E-4	12.7	.173	.122 E-3	.327 E-4	355.0	-.122
	39	.399 E-4	.184 E-4	17.2	.219	.936 E-4	.191 E-4	1.5	.451

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION II

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
174	0	326 E-4	139 E-4	-.159	.0117	458 E-4	143 E-4	2.61	.0559
	1	988 E-4	150 E-4	1.72	.268	107 E-3	185 E-4	47.1	.703
	6	912 E-4	149 E-4	1.15	.0152	454 E-4	319 E-4	28.1	-.0938
	12	423 E-4	131 E-4	351.7	-.174	124 E-3	130 E-4	333.2	-.743
	17	423 E-4	132 E-4	355.5	-.0942	981 E-4	140 E-4	356.0	-.156
	23	427 E-4	140 E-4	359.7	-.0053	112 E-3	340 E-4	22.7	.410
	28	341 E-4	137 E-4	.908	.0149	619 E-4	349 E-4	2.34	.0237
	34	416 E-4	140 E-4	4.63	.167	122 E-3	260 E-4	353.4	-.192
	39	402 E-4	142 E-4	2.2	.219	947 E-4	148 E-4	4.9	.469

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
196	0	.549 E-1	.947 E-2	3.21	1111	.678 E-1	.979 E-2	3.09	.120
	1	.649 E-1	.121 E-1	11.9	3.91	.413 E-0	.335 E-1	50.4	.846
	6	.527 E-1	.964 E-2	8.26	1.40	.529 E-1	.194 E-1	7.0	.205
	12	.632 E-1	.103 E-1	358.4	-.130	.328 E-0	.284 E-1	326.9	-.815
	17	.654 E-1	.102 E-1	357.4	-.096	.185 E-0	.185 E-1	350.5	-.421
	23	.686 E-1	.104 E-1	358.6	-.054	.448 E-0	.403 E-1	9.6	.692
	28	.578 E-1	.955 E-2	2.94	.0837	.120 E-0	.199 E-1	1.26	-.0119
	34	.696 E-1	.122 E-1	7.97	.246	.500 E-0	.567 E-1	352.9	-.730
	39	.669 E-1	.120 E-1	8.22	.293	.202 E-0	.267 E-1	13.3	.972

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
200	0	292 E-4	948 E-5	2.91	.0599	399 E-4	978 E-5	2.99	.105
	1	345 E-4	987 E-5	23.2	4.35	923 E-4	815 E-5	54.3	.824
	6	263 E-4	101 E-4	3.96	.0681	350 E-4	152 E-4	279.2	-.134
	12	379 E-4	855 E-5	344.5	-.304	185 E-3	654 E-5	326.0	-.867
	17	393 E-4	910 E-5	352.3	-.208	925 E-4	121 E-4	348.4	-.428
	23	415 E-4	103 E-4	356.1	-.102	125 E-3	408 E-4	10.2	.201
	28	323 E-4	974 E-5	2.57	.0569	786 E-4	323 E-4	4.67	.0744
	34	398 E-4	104 E-4	15.0	.340	131 E-3	341 E-4	5.01	.125
	39	371 E-4	987 E-5	18.3	.391	906 E-4	131 E-4	23.1	.637

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
208	0	318 E-4	137 E-4	2.48	.0375	437 E-4	140 E-4	3.95	.0623
	1	375 E-4	138 E-4	25.2	3.72	995 E-4	104 E-4	55.1	.793
	6	288 E-4	144 E-4	3.52	.0432	406 E-4	176 E-4	279.3	-.136
	12	413 E-4	123 E-4	346.9	-.274	113 E-3	877 E-5	325.6	-.839
	17	426 E-4	129 E-4	351.0	-.193	989 E-4	153 E-4	346.1	-.399
	23	448 E-4	141 E-4	355.2	-.102	132 E-3	440 E-4	10.3	.197
	28	351 E-4	138 E-4	2.16	.0368	832 E-4	359 E-4	4.89	.0733
	34	427 E-4	143 E-4	16.1	2.92	137 E-3	374 E-4	5.35	.128
	39	401 E-4	139 E-4	19.9	3.34	964 E-4	165 E-4	24.3	.601

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
214	0	281 E-4	.160 E-4	5.44	.0594	387 E-4	.163 E-4	5.62	.0871
	1	.539 E-4	.130 E-4	38.9	4.37	.969 E-4	.101 E-4	44.8	.731
	6	.237 E-4	.163 E-4	9.18	.062	.400 E-4	.669 E-5	276.7	-.218
	12	390 E-4	.143 E-4	338.2	-.386	.111 E-3	.136 E-4	315.2	-.382
	17	433 E-4	.155 E-4	343.5	-.267	.103 E-3	.219 E-4	337.8	-.514
	23	.449 E-4	.173 E-4	348.9	-.189	.162 E-3	.573 E-4	358.8	-.023
	28	331 E-4	.165 E-4	3.94	.0418	.105 E-3	.408 E-4	6.14	.1044
	34	.426 E-4	.162 E-4	22.1	.373	.159 E-3	.510 E-4	17.9	.3304
	39	386 E-4	.149 E-4	31.9	.406	.997 E-4	.212 E-4	35.8	.6294

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
215	0	.196 E-2	.652 E-4	11.5	.718	.234 E-2	.763 E-4	11.2	.738
	1	.214 E-1	.174 E-3	46.7	4.91		N	D	
	6	.209 E-2	.686 E-4	4.46	.293	.200 E-2	.793 E-4	33.5	.912
	12	.595 E-3	.486 E-4	10.4	.498	.209 E-3	.758 E-4	31.3	.927
	17	.629 E-3	.473 E-4	7.66	.407	.288 E-3	.980 E-4	359.2	-.027
	23	.677 E-3	.458 E-4	9.49	.269	.583 E-3	.318 E-4	9.241	-.769
	28	.186 E-2	.622 E-4	8.38	.466	.383 E-2	.677 E-4	357.7	-.727
	34	.267 E-2	.180 E-3	11.2	.917		N	D	
	39	.249 E-1	.177 E-3	13.7	.936		N	D	

λ_1, λ_2, β, ρ — FOR TOTAL ERRORS — MISSION III

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
12	0	.396 E-4	.147 E-4	5.28	.099	.539 E-4	.152 E-4	7.28	.167
	1	.416 E-4	.152 E-4	32.0	.946	.962 E-4	.957 E-5	68.0	.709
	6	.341 E-4	.148 E-4	5.11	.076	.384 E-4	.117 E-4	32.9	.412
	12	.520 E-4	.127 E-4	3.82	-.370	.130 E-3	.959 E-5	31.9	-.859
	17	.550 E-4	.141 E-4	3.57.8	-.178	.127 E-3	.203 E-4	39.81	-.385
	23	.595 E-4	.164 E-4	3.5.5	-.083	.190 E-3	.619 E-4	6.43	.137
	28	.456 E-4	.156 E-4	5.50	.107	.128 E-3	.491 E-4	9.68	.183
	34	.521 E-4	.168 E-4	9.0	.766	.189 E-3	.564 E-4	20.1	.916
	39	.470 E-4	.158 E-4	7.1	.821	.119 E-3	.280 E-4	26.7	.673

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
22	0	.389 E-4	.212 E-4	3.79	.029	.522 E-4	.224 E-4	3.40	.025
	1	.488 E-4	.196 E-4	5.33	.411	.170 E-3	.780 E-5	25.1	.739
	6	.347 E-4	.251 E-4	2.75	.068	.634 E-4	.123 E-4	20.5	-.529
	12	.654 E-4	.124 E-4	3.59.4	-.152	.224 E-3	.594 E-5	32.42	-.143
	17	.646 E-4	.124 E-4	3.44.2	-.434	.158 E-3	.106 E-4	24.42	-.587
	23	.651 E-4	.124 E-4	3.49.6	-.315	.173 E-3	.260 E-4	16.58	-.172
	28	.437 E-4	.179 E-4	4.5	.027	.106 E-3	.185 E-4	11.80	.368
	34	.523 E-4	.172 E-4	37.4	.849	.163 E-3	.220 E-4	26.2	.682
	39	.499 E-4	.185 E-4	43.6	.453	.127 E-3	.135 E-4	45.0	.808

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
28	0	.385 E-4	.179 E-4	4.26	.0580	.504 E-4	.164 E-4	6.13	.124
	1	.373 E-4	.190 E-4	10.4	.218	.821 E-4	.194 E-4	19.3	.627
	6	.361 E-4	.120 E-4	2.15	.0261	.965 E-4	.259 E-4	21.3	-.237
	12	.53 E-4	.17 E-4	3.2	.0237	.141 E-3	.142 E-4	34.1	-.657
	17	.549 E-4	.192 E-4	2.30	.0454	.120 E-3	.212 E-4	2.45	.083
	23	.55 E-4	.20 E-4	1.51	.113	.143 E-3	.119 E-4	22.7	.423
	28	.911 E-4	.137 E-4	4.15	.0255	.768 E-4	.741 E-4	4.81	.123
	34	.92 E-4	.191 E-4	4.74	.195	.117 E-3	.361 E-4	8.35	.0925
	39	.398 E-4	.194 E-4	4.19	.212	.823 E-4	.196 E-4	21.6	.506

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
34	0	.678 E-4	.149 E-4	10.42	.2829	.154 E-4	.153 E-4	2.745	.2340
	1	.115 E-3	.164 E-4	24.96	.6559	.172 E-3	.183 E-4	30.58	.6112
	6	.648 E-4	.164 E-4	15.91	.3946	.704 E-4	.223 E-4	8.55	.4176
	12	.441 E-4	.130 E-4	8.0.0	.2184	.176 E-4	.618 E-5	3.63	-.859
	17	.486 E-4	.117 E-4	2.50.9	.2359	.721 E-4	.710 E-5	3.38.0	-.659
	23	.585 E-4	.108 E-4	2.61.2	.2631	.120 E-3	.255 E-4	2.43.3	-.423
	28	.765 E-4	.139 E-4	4.59.0	.1685	.167 E-3	.227 E-4	8.53.1	.2484
	34	.130 E-3	.164 E-4	7.36	.5731	.499 E-3	.403 E-4	8.49.5	.8976
	39	.122 E-3	.163 E-4	20.64	.6169	.326 E-3	.241 E-4	25.43	.7970

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
37	0	.157 E-1	.105 E-2	81.9	.451	.211 E-1	.167 E-2	81.2	.511
	1	.183 E-1	.111 E-2	84.0	.366	.379 E-1	.156 E-2	72.1	-.388
	6	.155 E-1	.105 E-2	82.3	.430	.194 E-1	.137 E-2	85.0	.290
	12	.155 E-1	.104 E-2	80.1	.518	.249 E-1	.137 E-2	71.5	.772
	17	.157 E-1	.105 E-2	80.4	.509	.265 E-1	.114 E-2	78.3	.676
	23	.161 E-1	.107 E-2	80.8	.496	.329 E-1	.163 E-2	86.0	.286
	28	.159 E-1	.107 E-2	81.5	.486	.251 E-1	.161 E-2	80.5	.516
	34	.190 E-1	.114 E-2	82.4	.479	.514 E-1	.190 E-2	74.7	.786
	39	.186 E-1	.112 E-2	82.1	.474	.405 E-1	.128 E-2	83.9	.491

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
38	0	.894 E-3	.588 E-4	23.4	.798	.102 E-2	.603 E-4	23.6	.818
	1	.376 E-3	.457 E-4	2.12	.647	.206 E-3	.520 E-4	2.23	.0579
	6	.810 E-3	.584 E-4	20.6	.752	.885 E-3	.709 E-4	2.50	.145
	12	.352 E-2	.101 E-3	20.0	.879		MD		
	17	.354 E-2	.100 E-3	22.5	.898		MD		
	23	.360 E-2	.992 E-4	25.4	.915		ND		
	28	.995 E-3	.602 E-4	24.1	.834	.163 E-2	.669 E-4	23.1	.921
	34	.384 E-3	.440 E-4	21.3	.729	.251 E-3	.372 E-4	27.9	.740
	39	.379 E-3	.447 E-4	24.5	.691	.200 E-3	.371 E-4	29.1	.627

$\lambda_1, \lambda_2, \beta, \rho$ FOR TOTAL ERRORS — MISSION III

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
39	0	.258 E-2	.380 E-4	22.2	.730	.292 E-2	.104 E-3	24.5	.735
	1	.685 E-3	.397 E-4	5.6	.554	.184 E-3	.238 E-4	6.9	.573
	6	.186 E-2	.810 E-4	25.3	.748	.612 E-3	.554 E-4	10.9	.821
	12	.196	.603 E-3	3.3	.324		ND		
	17		ND				ND		
	23		ND				ND		
	28	.331 E-2	.122 E-3	29.0	.711		ND		
	34	.835 E-3	.431 E-4	19.2	.320	.955 E-3	.363 E-4	6.9	.277
	39	.783 E-3	.404 E-4	19.1	.314	.378 E-3	.217 E-4	17.2	.160

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
41	0	.704 E-4	.266 E-4	15.0	.283	.196 E-3	.373 E-4	9.5	.292
	1	.435 E-4	.235 E-4	3.5	.208	.655 E-4	.401 E-4	1.1	.214
	6	.614 E-4	.257 E-4	11.0	.166	.629 E-4	.188 E-4	3.2	.527
	12	.189 E-3	.335 E-4	3.52	.688	.294 E-3	.361 E-4	39.7	.631
	17	.124 E-3	.324 E-4	2.30	.178	.316 E-3	.510 E-4	2.96	.011
	23	.132 E-3	.355 E-4	11.6	.267	.193 E-3	.992 E-4	22.3	.530
	28	.908 E-4	.288 E-4	18.2	.305	.202 E-3	.602 E-4	31.28	.992
	34	.561 E-4	.242 E-4	15.7	.379	.143 E-3	.524 E-4	41.7	.960
	39	.501 E-4	.234 E-4	13.4	.347	.895 E-4	.206 E-4	49.2	.529

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
47	0	.330 E-4	.113 E-4	5.10	.099	.446 E-4	.117 E-4	6.90	.170
	1	.922 E-4	.122 E-4	7.58	.178	.166 E-3	.424 E-5	60.4	.799
	6	.295 E-4	.120 E-4	7.15	.114	.364 E-4	.146 E-4	2827	.199
	12	.381 E-4	.921 E-5	39.12	2.32	.992 E-4	.532 E-5	32.9	.873
	17	.319 E-4	.100 E-4	25.5	1.80	.880 E-4	.131 E-4	30.1	.347
	23	.427 E-4	.115 E-4	25.6	1.67	.121 E-3	.477 E-4	7.47	.123
	28	.368 E-4	.115 E-4	22.61	.850	.342 E-4	.177 E-3	12.17	.040
	34	.498 E-4	.129 E-4	21.0	.910	.177 E-3	.373 E-4	11.1	.310
	39	.129 E-4	.123 E-4	12.6	.492	.115 E-3	.163 E-4	14.6	.699

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
55	0	.464 E-4	.133 E-4	14.3	.304	.591 E-4	.136 E-4	19.2	.352
	1	.291 E-4	.128 E-4	13.2	.293	.489 E-4	.123 E-4	13.7	.329
	6	.921 E-4	.128 E-4	10.0	.211	.523 E-4	.153 E-4	19.1	.599
	12	.820 E-4	.143 E-4	24.7	.297	.221 E-3	.139 E-4	36.9	.637
	17	.835 E-4	.154 E-4	11.3	.392	.207 E-3	.219 E-4	23.4	.329
	23	.862 E-4	.169 E-4	15.6	.926	.272 E-3	.482 E-4	30.4	.689
	28	.513 E-4	.144 E-4	18.2	.374	.106 E-3	.371 E-4	35.7	.964
	34	.344 E-4	.130 E-4	26.2	.372	.770 E-4	.364 E-4	23.2	.268
	39	.319 E-4	.125 E-4	24.9	.348	.515 E-4	.126 E-4	29.8	.582

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
63	0	.386 E-4	.117 E-4	8.88	.468	.502 E-4	.120 E-4	7.68	.202
	1	.665 E-4	.128 E-4	27.79	.573	.150 E-3	.119 E-4	12.80	.633
	6	.357 E-4	.128 E-4	12.43	.215	.436 E-4	.137 E-4	32.23	.204
	12	.339 E-4	.833 E-5	39.5	.376	.808 E-4	.303 E-5	20.1	.258
	17	.367 E-4	.846 E-5	24.5	.339	.716 E-4	.882 E-5	20.9	.108
	23	.402 E-4	.931 E-5	24.9	.298	.109 E-3	.381 E-4	28.3	.162
	28	.427 E-4	.112 E-4	23.90	.260	.114 E-3	.277 E-4	36.1	.1041
	34	.701 E-4	.134 E-4	19.78	.406	.263 E-3	.395 E-4	19.91	.3753
	39	.652 E-4	.130 E-4	22.56	.536	.169 E-3	.195 E-4	26.78	.1395

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
69	0	.377 E-4	.118 E-4	7.04	.180	.492 E-4	.121 E-4	10.0	.252
	1	.306 E-4	.122 E-4	28.8	.321	.634 E-4	.118 E-4	6.3	.510
	6	.345 E-4	.115 E-4	6.21	.172	.414 E-4	.161 E-4	8.4	.227
	12	.588 E-4	.118 E-4	9.96	.706	.156 E-3	.103 E-4	24.0	.249
	17	.160 E-4	.130 E-4	5.60	.162	.192 E-3	.181 E-4	2.71	.114
	23	.622 E-4	.147 E-4	7.76	.254	.135 E-3	.489 E-3	25.8	.992
	28	.415 E-4	.122 E-4	11.6	.238	.882 E-4	.390 E-4	23.8	.296
	34	.364 E-4	.126 E-4	20.1	.338	.101 E-3	.356 E-4	13.7	.243
	39	.356 E-4	.120 E-4	21.2	.340	.669 E-4	.137 E-4	30.6	.610

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION II

FRAME 72

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	.743 E-4	.149 E-4	17.88	4519	.890 E-4	.153 E-4	15.92	.4559
1	.132 E-3	.134 E-4	26.53	7510	.322 E-3	.113 E-4	48.12	.9314
6	.738 E-4	.150 E-4	22.50	5297	.876 E-4	.178 E-4	39.56	.6189
12	.428 E-4	.169 E-4	14.68	2980	.616 E-4	.154 E-4	31.9	.4191
17	.468 E-4	.155 E-4	2.390	.0482	.591 E-4	.137 E-4	32.1	.4231
23	.521 E-4	.146 E-4	360.0	.659 E-4	.102 E-3	.288 E-4	34.39	.2397
28	.760 E-4	.145 E-4	12.13	3563	.159 E-3	.237 E-4	5.46	.2022
34	.143 E-3	.143 E-4	9.52	.6866	.523 E-3	.335 E-4	8.193	.4625
39	.137 E-3	.136 E-4	22.79	.9110	.359 E-3	.182 E-4	25.25	.9264

FRAME 73

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	.689 E-3	.500 E-4	20.76	.7518	.810 E-3	.611 E-4	20.31	.7991
1	.204 E-2	.738 E-4	28.29	.9041	.2168 E-2	.232 E-3	46.50	.9967
6	.694 E-3	.508 E-4	24.36	.8816	.817 E-3	.493 E-4	46.76	.9510
12	.286 E-3	.455 E-4	17.13	.5103	.152 E-3	.799 E-4	14.32	.2963
17	.308 E-3	.426 E-4	14.02	.4794	.182 E-3	.434 E-4	35.74	.2019
23	.340 E-3	.422 E-4	10.45	.4114	.428 E-3	.382 E-4	34.72	.5882
28	.291 E-3	.493 E-4	19.25	.1014	.154 E-2	.569 E-4	31.40	.9826
34	.246 E-2	.790 E-4	22.46	.9264		ND		
39	.225 E-2	.745 E-4	25.16	.9151	.2466 E-2	.325 E-3	3.53	.9946

FRAME 75

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	.373 E-4	.287 E-4	201.4	.2779	.434 E-4	.338 E-4	34.41	.0453
1	.451 E-4	.234 E-4	16.05	.1450	.114 E-3	.161 E-4	54.16	.2250
6	.363 E-4	.236 E-4	29.53	.1465	.604 E-4	.508 E-4	12.49	.1611
12	.564 E-4	.228 E-4	32.22	.4141	.150 E-3	.225 E-4	32.0	.2736
17	.579 E-4	.263 E-4	32.71	.3960	.137 E-3	.365 E-4	33.20	.5079
23	.611 E-4	.308 E-4	33.3	.2681	.215 E-3	.864 E-4	35.9	.2839
28	.412 E-4	.328 E-4	33.2	.0785	.132 E-3	.619 E-4	1.009	.1894
34	.479 E-4	.321 E-4	16.39	.2009	.209 E-3	.597 E-4	22.15	.4104
39	.468 E-4	.282 E-4	15.96	.1810	.117 E-3	.363 E-4	15.31	.9979

FRAME 78

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	.686 E-2	.160 E-3	3.664	.3232	.845 E-2	.168 E-3	3.586	.9968
1	.127 E-2	.114 E-3	1.938	.1024	.1426 E-2	.459 E-3	29.26	.9787
6	.574 E-2	.159 E-3	3.536	.2339	.869 E-2	.255 E-3	9.415	.9624
12		ND				ND		
17		ND				ND		
23		ND				ND		
28	.838 E-2	.163 E-3	5.796	6.934	.130 E-1	.170 E-3	2.791	.3992
34	.128 E-2	.103 E-3	2.104	.4131	.687 E-3	.530 E-4	30.13	.9743
39	.127 E-2	.102 E-3	5.343	.2946	.492 E-3	.991 E-4	14.43	.3946

FRAME 81

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	.297 E-4	.134 E-4	3.977	.0568	.399 E-4	.137 E-4	1.092	.1171
1	.407 E-4	.143 E-4	27.16	.4059	.108 E-3	.116 E-4	57.98	.9739
6	.275 E-4	.143 E-4	.912	.0192	.401 E-4	.178 E-4	28.01	.1437
12	.336 E-4	.115 E-4	3.456	.2146	.716 E-4	.251 E-5	31.12	.3649
17	.346 E-4	.121 E-4	352.1	.1418	.714 E-4	.141 E-4	353.1	.2177
23	.362 E-4	.134 E-4	3.554	.0621	.709 E-4	.453 E-4	14.52	.1151
28	.325 E-4	.134 E-4	2.845	.9326	.1745 E-4	.332 E-4	3.984	.6491
34	.446 E-4	.145 E-4	6.98	.3214	.157 E-3	.321 E-6	2.394	.4.0
39	.434 E-4	.142 E-4	21.09	.3622	.107 E-3	.165 E-4	5.9	.6417

FRAME 89

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	.773 E-4	.118 E-4	18.83	.5580	.927 E-4	.122 E-4	16.20	.5780
1	.406 E-4	.105 E-4	23.09	.4444	.302 E-4	.150 E-4	69.99	.0164
6	.699 E-4	.112 E-4	16.02	.4635	.746 E-4	.128 E-4	34.22	.5029
12	.143 E-3	.147 E-4	11.93	.4537	.375 E-3	.206 E-4	351.0	.5279
17	.147 E-3	.156 E-4	5.16	.5620	.383 E-3	.279 E-4	9.911	.9883
23	.153 E-3	.171 E-4	16.93	.6317	.539 E-3	.544 E-4	20.89	.9814
28	.862 E-4	.129 E-4	22.31	.6113	.1265 E-3	.321 E-4	39.63	.6818
34	.477 E-4	.105 E-4	20.24	.5984	.816 E-4	.290 E-4	95.19	.9759
39	.113 E-4	.102 E-4	29.21	.5461	.479 E-4	.911 E-5	41.42	.6765

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION III

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
97	0	.345 E-4	.137 E-4	19.6	.177	.419 E-4	.140 E-4	11.3	.239
	1	.238 E-4	.135 E-4	30.7	.242	.541 E-4	.842 E-5	75.3	.476
	6	.307 E-4	.132 E-4	25.3	.088	.142 E-4	.111 E-4	21.6	.582
	12	.602 E-4	.142 E-4	27.7	.097	.166 E-3	.132 E-4	34.9	.653
	17	.615 E-4	.155 E-4	7.04	.178	.153 E-3	.226 E-4	3.21	.127
	23	.641 E-4	.174 E-4	11.9	.272	.208 E-3	.528 E-4	27.3	.517
	28	.388 E-4	.150 E-4	19.9	.239	.302 E-4	.900 E-4	31.4	.278
	34	.234 E-4	.141 E-4	27.6	.296	.638 E-4	.395 E-4	20.3	.247
	39	.267 E-4	.134 E-4	28.4	.282	.532 E-4	.191 E-4	32.2	.553

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
102	0	.266 E-3	.319 E-4	35.0	.028	.309 E-3	.327 E-4	2.21	.058
	1	.487 E-3	.413 E-4	10.9	.506	.989 E-3	.665 E-4	34.3	.810
	6	.255 E-3	.320 E-4	9.19	.117	.487 E-3	.332 E-4	28.6	.634
	12	.139 E-3	.259 E-4	35.1	.258	.606 E-4	.290 E-4	32.3	.343
	17	.159 E-3	.254 E-4	34.8	.336	.120 E-3	.186 E-4	35.0	.635
	23	.174 E-3	.254 E-4	34.5	.426	.297 E-3	.333 E-4	32.2	.759
	28	.280 E-5	.320 E-4	35.1	.131	.705 E-3	.503 E-4	34.3	.671
	34	.597 E-3	.455 E-4	5.68	.313	.786 E-2	.142 E-3	35.4	.314
	39	.542 E-3	.434 E-4	8.03	.410	.233 E-2	.881 E-4	19.3	.263

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
120	0	.204 E-2	.799 E-4	78.1	.700	.228 E-2	.871 E-4	77.2	.725
	1	.644 E-3	.329 E-4	83.1	.440	.177 E-3	.252 E-4	79.6	.325
	6	.149 E-2	.662 E-4	76.6	.713	.592 E-3	.958 E-4	82.2	.795
	12	.153 E-1	.279 E-3	70.0	.918		N D		
	17	.322 E-1	.363 E-3	72.1	.939		N D		
	23	.313	.589 E-3	75.0	.935		N D		
	28	.296 E-2	.100 E-3	79.5	.686		N D		
	34	.862 E-3	.380 E-4	82.1	.222	.116 E-2	.381 E-4	29.5	.659
	39	.751 E-3	.357 E-4	85.2	.335	.407 E-3	.183 E-4	25.4	.330

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
121	0	.641 E-1	.113 E-1	359.2	-.016	.782 E-1	.117 E-1	359.1	-.033
	1	.140 E-0	.201 E-1	9.22	.352		N D		
	6	.644 E-1	.119 E-1	2.79	.092	.921 E-1	.227 E-1	9.62	.518
	12	.977 E-1	.982 E-2	353.0	-.206	.751 E-1	.197 E-1	342.7	-.345
	17	.997 E-1	.963 E-2	352.2	-.337	.722 E-1	.119 E-1	342.3	-.512
	23	.825 E-1	.962 E-2	351.3	-.333	.112 E-0	.201 E-1	341.8	-.372
	28	.699 E-1	.111 E-1	358.1	-.134	.140 E-0	.192 E-1	358.2	-.625
	34	.147 E-0	.203 E-1	359.2	-.030		N D		
	39	.142 E-0	.200 E-1	3.98	.157		N D		

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
136	0	.148 E-2	.630 E-4	12.7	.195	.169 E-2	.664 E-4	12.2	.812
	1	.495 E-3	.317 E-4	14.7	.686	.165 E-3	.316 E-4	60.8	.619
	6	.118 E-2	.566 E-4	20.5	.908	.719 E-3	.511 E-4	62.8	.859
	12	.105 E-1	.214 E-3	65.6	.929		N D		
	17	.138 E-1	.235 E-3	68.9	.930		N D		
	23	.204 E-1	.269 E-3	71.1	.932		N D		
	28	.187 E-2	.720 E-4	14.6	.178	.102 E-1	.160 E-3	59.2	.108
	34	.584 E-3	.323 E-4	20.0	.565	.542 E-3	.241 E-4	28.7	.638
	39	.549 E-3	.318 E-4	17.1	.629	.270 E-3	.192 E-4	54.5	.205

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
140	0	.125 E-2	.481 E-4	13.0	.908	.184 E-2	.505 E-4	12.6	.816
	1	.435 E-3	.247 E-4	13.3	.136	.158 E-3	.178 E-4	55.9	.117
	6	.103 E-2	.431 E-4	16.5	.528	.715 E-3	.295 E-4	57.1	.117
	12	.625 E-2	.148 E-3	61.7	.932		N D		
	17	.103 E-1	.183 E-3	66.0	.929		N D		
	23	.142 E-1	.183 E-3	62.3	.925		N D		
	28	.154 E-2	.546 E-4	15.4	.181	.578 E-2	.114 E-3	29.1	.113
	34	.493 E-3	.258 E-4	19.2	.604	.375 E-3	.289 E-4	61.3	.610
	39	.464 E-3	.252 E-4	16.6	.614	.215 E-3	.152 E-4	53.4	.266

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION III

FRAME 148

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	173 E-3	145 E-4	20.6	-.744	228 E-3	150 E-4	20.5	.763
1	972 E-4	122 E-4	20.0	-.620	476 E-4	281 E-4	352.1	-.789
6	178 E-3	142 E-4	7.3	-.679	191 E-3	127 E-4	25.1	-.282

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
12	397 E-3	196 E-4	15.8	-.744	.144 E-2	353 E-4	357.7	-.237
17	403 E-3	202 E-4	19.5	-.767	.146 E-2	355 E-4	15.1	-.533
23	413 E-3	209 E-4	20.5	-.824	.199 E-2	553 E-4	35.1	-.940

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
28	212 E-3	151 E-4	23.7	-.788	364 E-3	253 E-4	41.1	-.968
34	104 E-3	114 E-4	27.5	-.741	105 E-3	169 E-4	49.5	-.720
39	101 E-3	117 E-4	24.2	-.697	672 E-4	721 E-5	34.6	-.735

FRAME 156

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	326 E-4	158 E-4	359.2	-.0109	439 E-4	164 E-4	2.37	.0602
1	330 E-4	177 E-4	26.0	.304	104 E-3	146 E-4	60.4	.702
6	299 E-4	167 E-4	359.1	-.0079	453 E-4	197 E-4	40.3	-.268

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
12	407 E-4	135 E-4	347.9	-.232	112 E-3	364 E-5	332.5	.804
17	413 E-4	144 E-4	351.6	-.158	907 E-4	167 E-4	354.0	.193
23	426 E-4	160 E-4	355.3	-.0822	110 E-3	573 E-4	7.3	-.227

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
28	354 E-4	159 E-4	359.2	-.0108	780 E-4	384 E-4	359.3	-.0069
34	447 E-4	174 E-4	15.5	.244	149 E-3	951 E-4	5.27	.142
39	419 E-4	173 E-4	19.1	.279	101 E-3	191 E-4	26.2	.575

FRAME 161

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	178 E-2	109 E-3	98.4	.0422	180 E-2	144 E-3	88.9	.0632
1	115 E-2	717 E-4	278.4	-.475	320 E-3	258 E-4	89.7	-.717
6	124 E-2	798 E-4	270.0	-.0003	294 E-3	232 E-4	89.5	.0265

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
12	159 E-2	103 E-3	90.3	-.523	.499 E-3	.482 E-4	66.7	-.726
17	224 E-2	137 E-3	90.6	.523	.316 E-2	.225 E-3	71.3	.726
23	377 E-2	201 E-3	90.9	.537	ND			

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
28	276 E-2	156 E-3	98.7	.0867	ND			
34	232 E-2	130 E-3	278.4	-.499	ND			
39	163 E-2	975 E-4	278.4	-.485	214 E-2	142 E-3	297.7	-.723

FRAME 166

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	405 E-4	.122 E-4	7.67	.166	488 E-4	126 E-4	2.45	.185
1	725 E-4	.151 E-4	31.6	.642	177 E-3	514 E-4	59.3	.501
6	357 E-4	.132 E-4	16.5	.271	548 E-4	743 E-5	24.9	.508

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
12	327 E-4	716 E-5	327.1	-.602	931 E-4	172 E-5	295.9	-.893
17	373 E-4	691 E-5	333.2	-.606	1819 E-4	377 E-5	319.9	-.909
23	444 E-4	691 E-5	331.5	-.609	.165 E-3	261 E-4	335.8	-.622

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
28	471 E-4	.113 E-4	1.91	.052	170 E-3	261 E-4	355.8	.151
34	877 E-4	.171 E-4	2.26	.542	422 E-3	728 E-4	1.6	.533
39	798 E-4	.161 E-4	2.03	.578	223 E-3	446 E-4	3.71	.653

FRAME 171

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	127 E-2	698 E-4	25.8	.201	140 E-2	690 E-4	25.0	.230
1	450 E-3	296 E-4	29.5	.595	128 E-3	268 E-4	69.5	.493
6	192 E-3	553 E-4	25.9	.229	500 E-3	426 E-4	56.3	.821

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
12	568 E-2	.196 E-3	68.4	.871				
17	764 E-2	224 E-3	70.5	.872	ND			
23	118 E-1	267 E-3	71.1	.875				

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
28	168 E-2	775 E-4	27.6	.682	162 E-1	241 E-3	270.6	-.684
34	572 E-3	323 E-4	84.9	.357	705 E-3	299 E-4	289.3	-.744
39	510 E-3	308 E-4	82.3	.455	279 E-3	172 E-4	272.8	-.682

FRAME 172

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
0	223 E-2	884 E-4	25.3	.269	250 E-2	943 E-4	24.6	.285
1	637 E-3	351 E-4	29.0	.603	168 E-3	285 E-4	69.3	.554
6	162 E-2	728 E-4	23.5	.275	699 E-3	500 E-4	57.2	.895

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
12	409 E-1	432 E-3	68.5	.954				
17	.370 E-0	598 E-3	71.1	.982	ND			
23	ND		72.6	.753				

POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
28	325 E-2	.111 E-3	77.0	.953	535 E-0	622 E-3	271.9	-.690
34	832 E-3	393 E-4	83.6	.835	998 E-3	344 E-4	283.2	-.758
39	733 E-3	370 E-4	81.6	.523	370 E-3	.179 E-4	271.5	-.108

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION III

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
176	0	360 E-4	149 E-4	2.5	.058	486 E-4	154 E-4	2.22	.130
	1	341 E-4	161 E-4	2.40	.273	826 E-4	139 E-4	6.17	.021
	6	331 E-4	152 E-4	1.23	.017	461 E-4	199 E-4	2.16	.382
	12	523 E-4	141 E-4	3.72	.098	146 E-3	105 E-4	33.83	.265
	17	530 E-4	152 E-4	3.48	.008	123 E-3	188 E-4	5.45	.020
	23	594 E-4	169 E-4	3.08	.087	153 E-3	509 E-4	23.7	.394
	28	392 E-4	156 E-4	2.42	.092	822 E-4	417 E-4	13.7	.157
	34	397 E-4	158 E-4	2.71	2.60	120 E-3	354 E-4	8.12	.179
	39	370 E-4	156 E-4	2.48	2.74	818 E-4	166 E-4	27.9	5.81

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
182	0	644 E-4	166 E-4	5.5	.351	800 E-4	170 E-4	5.2	.396
	1	370 E-4	156 E-4	2.12	.287	965 E-4	167 E-4	7.8	.191
	6	587 E-4	161 E-4	4.2	.255	700 E-4	179 E-4	3.82	.389
	12	116 E-3	187 E-4	8.24	.305	315 E-4	203 E-4	1.486	.381
	17	118 E-3	198 E-4	7.25	.395	300 E-3	268 E-4	8.36	.387
	23	122 E-3	213 E-4	6.72	.435	394 E-3	555 E-4	3.05	.209
	28	711 E-4	177 E-4	9.3	.425	142 E-3	389 E-4	3.71	.584
	34	491 E-4	155 E-4	2.24	.401	803 E-4	366 E-4	3.38	.349
	39	402 E-4	152 E-4	2.49	3.60	526 E-4	140 E-4	27.5	.567

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
192	0	.479 E-4	.123 E-4	12.19	.2811	.619 E-4	.127 E-4	2.40	.3458
	1	.319 E-4	.122 E-4	22.62	.3356	.556 E-4	.123 E-4	7.091	.4553
	6	.435 E-4	.120 E-4	6.542	.1079	.530 E-4	.163 E-4	32.15	.4988
	12	.817 E-4	.133 E-4	5.20	.1043	.222 E-3	.130 E-4	3.450	.6284
	17	.832 E-4	.143 E-4	5.229	.2899	.265 E-3	.209 E-4	5.172	.2447
	23	.858 E-4	.159 E-4	2.99	.3827	.265 E-3	.494 E-4	27.89	.6130
	28	.528 E-4	.133 E-4	5.50	.3561	.110 E-3	.392 E-4	2.73	.4440
	34	.399 E-4	.120 E-4	23.99	.4098	.899 E-4	.344 E-4	2.161	.3231
	39	.351 E-4	.117 E-4	23.37	.3812	.600 E-4	.117 E-4	23.97	.6438

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
202	0	.387 E-4	.120 E-4	2.13	.150	.523 E-4	.124 E-4	2.83	.222
	1	.352 E-4	.128 E-4	2.15	.320	.767 E-4	.113 E-4	6.36	.670
	6	.357 E-4	.127 E-4	5.23	.191	.426 E-4	.188 E-4	2.117	.388
	12	.544 E-4	.115 E-4	3.89	.648	.153 E-3	.884 E-5	2.29	.179
	17	.573 E-4	.125 E-4	1.92	.0565	.126 E-3	.167 E-4	4.59	.0420
	23	.611 E-4	.141 E-4	5.73	.158	.173 E-3	.482 E-4	21.5	.424
	28	.445 E-4	.127 E-4	2.82	.190	.928 E-4	.380 E-4	1.64	.2.28
	34	.413 E-4	.127 E-4	6.23	.321	.124 E-3	.344 E-4	1.86	.1651
	39	.388 E-4	.129 E-4	6.23	.320	.837 E-4	.123 E-4	29.1	.1662

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
208	0	.111 E-3	.306 E-4	6.1	.351	.128 E-3	.359 E-4	1.84	.3419
	1	.203 E-3	.315 E-4	29.1	.628	.476 E-3	.788 E-4	5.21	.2908
	6	.107 E-3	.309 E-4	2.23	.423	.129 E-3	.122 E-4	6.19	.6236
	12	.602 E-4	.233 E-4	3.98	.1053	.114 E-3	.115 E-4	2.25	.1673
	17	.693 E-4	.306 E-4	2.91	.1146	.993 E-4	.176 E-4	3.28	.1691
	23	.819 E-4	.275 E-4	2.92	.1139	.207 E-3	.244 E-4	3.351	.1700
	28	.119 E-3	.252 E-4	2.3	.257	.310 E-3	.349 E-4	3.553	.1212
	34	.234 E-3	.323 E-4	2.18	.618	.125 E-2	.889 E-4	14.0	.6351
	39	.214 E-3	.324 E-4	2.30	.647	.670 E-3	.668 E-4	21.6	.7857

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
213	0	486 E-2	982 E-4	21.3	.920	.610 E-2	.101 E-3	21.2	.932
	1	108 E-2	491 E-4	21.7	.838	.341 E-3	.605 E-4	8.85	.285
	6	386 E-2	995 E-4	18.9	.891	.273 E-2	.968 E-4	2.05	.182
	12								
	17								
	23								
	28	656 E-2	109 E-3	23.7	.992	.120 E-0	.999 E-1	39.6	.986
	34	.121 E-2	475 E-4	27.0	.891	203 E-1	213 E-1	96.4	.931
	39	.115 E-2	481 E-4	24.6	.871	.191 E-1	.129 E-1	32.4	.854

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION III

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
215	0	.732 E-4	.248 E-4	343.3	-.312	.828 E-4	.271 E-4	326.7	-.259	12	.942 E-4	.191 E-4	339.3	-.508	.186 E-3	.363 E-4	319.9	-.673	28	.812 E-4	.269 E-4	345.2	-.275	.207 E-3	.654 E-4	2.58	.055
	1	.599 E-4	.405 E-4	350.3	-.065	.116 E-3	.556 E-4	328.7	-.112	17	.985 E-4	.214 E-4	336.9	-.517	.194 E-3	.344 E-4	331.6	-.632	34	.746 E-4	.433 E-4	2.02	.019	.265 E-3	.101 E-4	30.1	.359
	6	.666 E-4	.235 E-4	338.2	-.393	.697 E-4	.201 E-4	310.1	-.530	23	.105 E-3	.249 E-4	339.9	-.851	.311 E-3	.832 E-4	319.2	-.953	39	.611 E-4	.419 E-4	358.0	.016	.135 E-3	.695 E-4	78.5	.317
FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
	0									12									28								
	1									17									34								
	6									23									39								
FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
	0									12									28								
	1									17									34								
	6									23									39								
FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
	0									12									28								
	1									17									34								
	6									23									39								
FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
	0									12									28								
	1									17									34								
	6									23									39								
FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
	0									12									28								
	1									17									34								
	6									23									39								

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION IV

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
6	0	.474 E-0	.142 E-0	84.0	-.288	.567 E-0	.175 E-0	88.7	-.347
	1	.261 E-0	.935 E-1	9.80	.198			ND	
	6	.486 E-0	.102 E-0	86.5	-.927				
10	0	.363	.159	31.6	-.324	.509	.173	32.3	-.483
	1	.433	.117	2.96	.048			ND	
	6	.321	.163	31.3	-.324			ND	
14	0	.348	.115	35.3	-.0923	.479	.124	35.3	-.119
	1	.472	.109	3.2	.334			ND	
	6	.307	.117	35.8	-.0556	.715	.216	67.3	.412
18	0	.493	.143	6.66	.150	.695	.153	6.59	.186
	1	.704	.172	2.16	.549			ND	
	6	.445	.145	9.95	.196	.624	.295	86.2	.0573
22	0	.805	.312	34.2	.417	1.13	.338	31.7	.498
	1	2.99	2.42	2.6	.678			ND	
	6	.795	.300	44.2	.452	.527	.525	30.0	.866
25	0	.586 E-0	.197 E-0	1.13	.023	.694 E-0	.208 E-0	.988	.022
	1	.186 E+1	.435 E-0	5.70	.154			ND	
	6	.521 E-0	.181 E-0	2.10	.052			ND	

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
6	12	.652 E+1	.105 E-0	82.3	.714				
	17	.856 E+1	.279 E-0	87.7	.212			ND	
	23	.340 E+2	.527 E-1	27.4	.510				
10	12	1.66	.119	28.4	-.536			ND	
	17	1.70	.128	28.5	-.654			ND	
	23	1.71	.154	29.1	-.700			ND	
14	12	.485	.137	32.8	-.512			ND	
	17	.501	.143	33.3	-.457	25.78	.531	206.3	-.956
	23	.533	.154	34.2	-.363			ND	
18	12	.637	.135	35.1	-.257			ND	
	17	.650	.138	35.9	-.184	14.44	.361	35.87	-.141
	23	.749	.147	35.6	-.100			ND	
22	12	.994	.227	35.1	-.0971			ND	
	17	1.03	.231	1.08	.0367			ND	
	23	1.11	.243	1.82	.0527			ND	
25	12		ND			N	D		
	17		ND			N	D		
	23								

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
6	28	.979 E-0	.182 E-0	83.7	.109	.996 E-0	.232 E-0	84.3	.487
	34	.305 E-0	.799 E-1	20.4	.927			ND	
	39	.278 E-0	.818 E-1	15.5	.317				
10	28	.416	.168	31.0	-.426	1.31	.473	40.5	.466
	34	.460	.119	3.536	.0652			ND	
	39	.441	.117	1.11	.277	10.7	.148	358.1	-.262
14	28	.379	.117	35.0	-.107	1.24	.542	12.0	.170
	34	.540	.116	6.58	.187			ND	
	39	.503	.111	9.30	.255	35.80	.370	351.2	-.828
18	28	.551	.145	8.37	.108	1.92	26.9	4.18	.0505
	34	.793	.240	17.2	.381			ND	
	39	.744	.128	12.6	.476			ND	
22	28	.841	.321	24.6	.349	2.71	1.27	332.0	-.300
	34	2.88	.323	63.4	.697			ND	
	39	3.01	.293	67.8	.712			ND	
25	28	.679 E-0	.245 E-0	2.29	.042			ND	
	34		MD					ND	
	39								

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION IV

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
30	0	1.06	.415	18.2	.228	1.49	.444	18.1	.355
	1	2.83	.395	22.2	.394		ND		
	6	.952	.415	32.5	.360	2.65	6.20	32.5	.592
42	0	2.76	.688	24.6	.362	13.4	.832	68.5	.445
	1	28.9	.578	17.3	.165		ND		
	6	4.74	.398	22.5	.153	4.76	.661	32.1	.263
65	0	.223	.558 E-1	35.9	.134	.324	.601 E-1	35.9	.164
	1	.312	.539 E-1	12.0	.379		ND		
	6	2.07	.554 E-1	35.1	.209	.354	.133	63.6	.372
66	0	.353	.824 E-1	6.29	.170	.418	.082	6.25	.205
	1	.493	.995 E-1	29.4	.597		ND		
	6	.316	.823 E-1	9.36	.224	.340	.190	81.4	.095
73	0	.496	.148	6.23	.137	.698	.159	6.16	.170
	1	.688	.181	22.0	.502		ND		
	6	.456	.150	9.87	.180	.626	.345	82.0	.0732
75	0	.682	.188	1.60	.032	.780	.198	1.46	.0358
	1	3.06	.371	32.5	.258		ND		
	6	.631	.202	8.59	.082		ND		

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
30	12	.730	.253	30.3	.0653		ND		
	17	2.09	.253	9.40	.0990		ND		
	23		ND				ND		
42	12	1.17	.462	2.16	.0339		ND		
	17	1.28	.442	3.55	.0838		ND		
	23	1.48	.459	3.42	.252		ND		
65	12	.329	.676 E-1	33.3	.163		ND		
	17	.342	.701 E-1	5.58	.558	23.7	.265	30.7	.972
	23	.363	.755 E-1	5.42	.453		ND		
66	12	.455	.787 E-1	35.1	.293		ND		
	17	.492	.807 E-1	5.36	.223	12.0	.238	35.5	.147
	23	.546	.861 E-1	5.14	.132		ND		
73	12	.630	.144	35.5	.210		ND		
	17	.688	.143	5.52	.147	17.4	.417	32.2	.0332
	23	.751	.156	5.81	.0563		ND		
75	12		ND				ND		
	17		ND				ND		
	23		ND				ND		

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
30	28	1.27	.423	9.45	.173		ND		
	34	1.72	.215	5.92	.325		ND		
	39	2.27	.489	16.7	.512		ND		
42	28	1.81	.864	22.1	.0573		ND		
	34		ND				ND		
	39		ND				ND		
65	28	.258	.574 E-1	32.9	.147	.867	.258	6.5	.435
	34	.362	.559 E-1	6.31	.230		ND		
	39	.328	.537 E-1	8.71	.200	2.42	.146	35.6	.534
66	28	39.8	.847 E-1	4.10	.121	1.43	.573	3.51	.0573
	34	.562	.115	6.9	.442		ND		
	39	.526	.106	22.1	.526	.253	1.19	11.0	.642
73	28	.548	.152	4.43	.100	1.83	1.01	3.89	.0813
	34	.768	.205	14.9	.330		ND		
	39	.724	.192	20.4	.422	30.2	1.84	8.52	.498
75	28	.759	.194	1.12	.0248		ND		
	34	2.63	.463	33.8	.174		ND		
	39	2.44	.415	13.1	.406		ND		

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION IV

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
84	0	.281	.8816	354.4	-1.28	.395	.87 E-1	-354.6	-1.53
	1	.382	.0765	10.4	.29		ND		
	6	.257	.8255 E-1	355.7	-.0883	.501	.199	63.6	354
	12	.400	.100	330.9	-.538		ND		
	17	.412	.104	334.6	-.478	25.7	.387	304.5	-.866
	23	.437	.111	24.32	-.379		ND		
	28	.310	.8446 E-1	358.6	-.131	.970	.374	12.1	.199
	34	.432	.8124 E-1	4.63	.148		ND		
	39	.405	.7991 E-1	2.04	.217	12.9	.236	353.2	.611

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
85	0	.410	.108	5.76	.1476	.1576	.116	5.92	.180
	1	.569	.131	2.70	.545		ND		
	6	.372	.1093	8.96	.193	.455	.252	80.9	.0843
	12	.533	.103	351.7	-.252		ND		
	17	.588	.1064	354.3	-.183	12.7	.289	358.8	-.138
	23	.623	.1127	357.1	-.0825		ND		
	28	.458	.1162	2.96	.1047	.1577	.732	8.86	.0661
	34	.643	.1582	5.3	.3724		ND		
	39	.603	.1337	20.6	.4617	24.8	.135	2.90	.482

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
101	0	.239	.555 E-1	354.9	-.153	.335	.601 E-1	354.4	-.186
	1	.323	.534 E-1	1.16	.374		ND		
	6	.219	.585 E-1	355.5	-.110	.344	.134	62.7	357.0
	12	.341	.6786 E-1	352.6	-.617		ND		
	17	.356	.7036 E-1	355.9	-.569	21.4	.258	303.7	-.972
	23	.383	.7551 E-1	341.3	-.481		ND		
	28	.268	.5766 E-1	354.1	-.170	.908	.252	98.3	.222
	34	.376	.5631 E-1	6.02	.223		ND		
	39	.348	.5428 E-1	8.34	.294	11.3	.169	354.8	-.580

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
102	0	.356	.814 E-1	5.69	.157	.501	.877 E-1	5.66	.186
	1	.493	.983 E-1	2.27	.594		ND		
	6	.319	.824 E-1	8.73	.214	.346	.187	79.9	.103
	12	.462	.7771 E-1	359.3	-.318		ND		
	17	.496	.7971 E-1	352.9	-.249	10.1	.219	354.9	-.340
	23	.550	.8501 E-1	355.6	-.162		ND		
	28	.401	.8341 E-1	2.52	.105	1.45	.541	2.35	.0412
	34	.567	.113	6.3	.435		ND		
	39	.528	.1051	2.15	.522	12.7	.100	10.4	.575

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
108	0	.275	.847 E-1	354.3	-.124	.392	.909 E-1	354.3	-.155
	1	.379	.812 E-1	10.4	.289		ND		
	6	.255	.854 E-1	355.4	-.0894	.517	.198	64.4	.363
	12	.398	.1041	350.1	-.531		ND		
	17	.410	.1071	355.9	-.475	23.9	.383	304.5	-.864
	23	.435	.1151	342.5	-.380		ND		
	28	.308	.8711 E-1	358.2	-.124	.961	.381	11.8	.188
	34	.429	.8491 E-1	4.54	.141		ND		
	39	.402	.8191 E-1	2.00	.209	13.1	.235	353.6	-.629

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
109	0	.402	.1057	5.72	.137	.565	.117	5.46	.168
	1	.556	.1321	2.69	.535		ND		
	6	.364	.1111	8.72	.186	.455	.247	81.3	.0908
	12	.521	.1051	351.3	-.257		ND		
	17	.556	.1071	353.9	-.183	11.0	.288	357.8	-.228
	23	.610	.1141	356.5	-.106		ND		
	28	.448	.1121	3.64	.0945	1.53	.717	4.52	.0608
	34	.628	.1521	5.1	.362		ND		
	39	.589	.1411	20.5	.454	19.2	1.23	2.20	.465

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION IV

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
120	0	.282	.814 E-1	354.4	-.121	.392	.876 E-1	354.6	-.158
	1	.380	.783 E-1	10.3	-.298		ND		
	6	.256	.823 E-1	354.7	-.103	.433	.197	63.7	.357
	12	.399	.100	330.6	-.539		ND		
	17	.411	.103	32.2	-.482	23.9	32.1	32.1	-.345
	23	.438	.110	342.8	-.381		ND		
	28	.309	.837 E-1	353.3	-.137	.965	.368	11.7	-.195
	34	.430	.818 E-1	4.55	-.145		ND		
	39	.403	.784 E-1	6.96	.213	12.7	.228	353.9	-.161

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
121	0	.400	.105	5.78	-.143	.561	.113	3.12	-.174
	1	.551	.128	24.1	-.540		ND		
	6	.362	.100	6.72	-.192	.434	.244	80.0	0.993
	12	.518	.101	351.5	-.258		ND		
	17	.553	.103	354.1	-.190	10.5	26.9	25.7.1	-.235
	23	.607	.110	356.8	-.106		ND		
	28	.446	.108	2.15	.099	1.52	.682	.420	-.059
	34	.624	.146	5.12	.371		ND		
	39	.584	.136	20.4	.462	17.1	1.13	9.82	-.521

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
125	0	.306	.553 E-1	354.2	-.186	.445	.595 E-1	354.3	-.213
	1	.414	.623 E-1	6.65	.244		ND		
	6	.284	.566 E-1	354.5	-.161	.368	.230	64.8	.231
	12	.424	.796 E-1	335.3	-.580		ND		
	17	.437	.803 E-1	340.0	-.523	2.14	.411	326.0	-.295
	23	.463	.840 E-1	345.5	-.424		ND		
	28	.334	.563 E-1	2.45	-.188	.988	.253	9.69	.234
	34	.464	.628 E-1	2.54	.103		ND		
	39	.439	.615 E-1	4.29	.168	14.5	.272	352.3	-.673

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
137	0	.245 E-0	.556 E-1	354.6	-.149	.345 E-0	.598 E-1	354.7	-.181
	1	.333 E-0	.526 E-1	12.5	.108		ND		
	6	.218 E-0	.562 E-2	359	-.103	.343 E-0	.127 E-0	63.2	.388
	12	.350 E-0	.669 E-1	339.3	-.632		ND		
	17	.366 E-0	.690 E-1	341.1	-.585	.202 E+2	.250 E-0	304.9	.572
	23	.396 E-0	.743 E-1	341.0	-.500		ND		
	28	.277 E-0	.571 E-1	3.43	-.169	.960 E-0	.253 E-0	9.99	.227
	34	.390 E-0	.557 E-1	1.83	.259		ND		
	39	.360 E-0	.535 E-1	9.19	.339	.121 E+2	.168 E-0	352.0	-.341

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
142(B)	0	.388 E-0	.133 E-0	354.9	-.357	.530 E-0	.143 E-0	351.8	-.440
	1	.573 E-0	.805 E-0	11.6	.352		ND		
	6	.341 E-0	.137 E-0	356.9	-.321				
	12	.166 E+1	.830 E-1	285.2	-.733				
	17	.173 E+1	.898 E-1	289.5	-.796		ND		
	23	.178 E+1	.109 E-0	294.9	-.823				
	28	.443 E-0	.136 E-0	355.9	-.327	.205 E+1	.274 E-0	351.0	-.764
	34	.598 E-0	.106 E-0	9.12	.253		ND		
	39	.577 E-0	.104 E-0	9.79	-.301	.125 E+2	.177 E-0	2.01	.279

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
143	0	.388 E-0	.973 E-1	354.9	-.132	.542 E-0	.103 E-0	354.8	-.149
	1	.528 E-0	.935 E-1	13.2	.399		ND		
	6	.445 E-0	.983 E-1	351.2	-.068	.590 E-0	.208 E-0	64.8	.388
	12	.556 E-0	.118 E-0	328.6	-.645		ND		
	17	.582 E-0	.123 E-0	334.2	-.558	.330 E+2	.476 E-0	344.2	-.967
	23	.625 E-0	.138 E-0	340.2	-.474		ND		
	28	.459 E-0	.100 E-0	354.5	-.152	.153 E+1	.437 E-0	9.85	.220
	34	.618 E-0	.988 E-1	2.37	.258		ND		
	39	.571 E-0	.956 E-1	9.80	.324	.187 E+2	.321 E-0	356.0	-.460

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION IV

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
144	0	504 E-0	.119 E-0	6.21	.166	706 E-0	.127 E-0	6.14	.201	12	649 E-0	.115 E-0	3.98	-.321		ND			28	571 E-0	.122 E-0	3.92	.115	.211 E+1	.756 E-0	1.83	.034
	1	701 E-0	.144 E-0	2.93	.599		ND			17	.701 E-0	.118 E-0	3.54	-.252	.120 E+2	.320 E-0	3.50	-.387	34	811 E-0	.167 E-0	1.80	.457		ND		
	6	448 E-0	.121 E-0	3.90	.221	484 E-0	.252 E-0	2.52	.088	23	780 E-0	.126 E-0	3.58.2	-.172		ND			39	753 E-0	.159 E-0	2.31	.536	.212 E+2	.140 E+1	1.62	.698
FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
146	0	.816	.212	3.44.3	-.342	1.02	.223	3.12.4	-.142	12	3.97	.345	3.31.1	-.796		ND			28	.705	.208	3.37.3	-.132		ND		
	1	.249	.885	3.22.8	-.601		ND			17	3.26	.329	3.13.3	-.616		ND			34	.349	.521	3.03.4	-.701		ND		
	6	.995	.243	3.41.4	-.447		ND			23	3.38	.346	-.672	.0326		ND			39	3.34	.1609	3.14.3	-.594		ND		
FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
154	0	.758	.022	69.1	.0933	.820	.022	69.1	.0933	12	.723	.168	20.3	-.335		ND			28	.553	.031	2.32	-.328	.860	.207	66.2	.472
	1	.265	.036	74.9	.508		ND			17	2.33	.102	28.0	-.669		ND			34	.227	.0499	5.12	-.315		ND		
	6	.511	.0216	92.2	.473		ND			23	22.1	.0211	27.8	-.715		ND			39	.254	.0401	78.2	-.330		ND		
FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
165	0	.536	.337	3.42.2	-.150	.646	.356	2.47.1	-.125	12		ND				ND			28	.563	.232	5.11	-.109	.157	.522	8.26	.498
	1		ND				ND			17		ND				ND			34	2.25	.192	2.3	-.702		ND		
	6	.577	.481	29.3	-.382		ND			23		ND				ND			39	1.23	.213	20.4	.362		ND		
FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
178	0	.372 E+1	.313 E-1	3.72	.031	.569 E-0	.303 E-0	.988	.022	12									28	.510 E-0	.221 E-0	3.58	-.133				
	1		ND				ND			17	ND		ND						34	.430 E+1	.762 E-0	4.2	.408	ND			
	6	.502 E-0	.368 E-0	3.2.3	.148					23									39		ND						
FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
	0									12									28								
	1									17									34								
	6									23									39								

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION V

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
21	0	.722 E+1	.100 E-0	239.8	-.814	.722 E+1	.914 E-1	280.1	-.836
	1	.861 E-0	.110 E-1	86.6	358	.810 E-0	.693 E-1	68.1	-.565
	6	.251 E+2	.311 E-1	89.9	-.227	.134 E+1	.179 E-0	69.1	.682
	12	ND	ND	ND	ND	ND	ND	ND	ND
	17	ND	ND	ND	ND	ND	ND	ND	ND
	23	ND	ND	ND	ND	ND	ND	ND	ND
	28	.132 E+1	.359 E-0	254.1	-.532	ND	ND	ND	ND
	34	.117 E+1	.108 E-1	232.2	-.359	ND	ND	ND	ND
	39	.103 E+1	.956 E-2	230.1	-.900	.490 E-0	.103 E-1	77.8	.673

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
22	0	.919 E-0	.168 E-1	248.3	-.509	.936 E-0	.160 E-1	234.7	-.522
	1	.953 E-0	.350 E-1	289.3	-.227	ND	ND	ND	ND
	6	.604 E-0	.168 E-1	230.1	-.068	.686 E-0	.165 E-0	76.6	.980
	12	.479 E+1	.358 E-1	88.6	26.5	ND	ND	ND	ND
	17	.141 E+2	.358 E-1	76.8	-.893	ND	ND	ND	ND
	23	ND	ND	ND	ND	ND	ND	ND	ND
	28	.203 E+1	.231 E-1	280	-.895	ND	ND	ND	ND
	34	ND	ND	ND	ND	ND	ND	ND	ND
	39	.606 E+1	.477 E-1	296.8	-.976	ND	ND	ND	ND

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
29	0	.986 E-0	.153 E-1	84.1	.986	.997 E-0	.155 E-1	84.1	.987
	1	.219 E+1	.196 E-1	85.8	.258	.158 E+1	.900 E-0	281.2	-.387
	6	.998 E-0	.153 E-1	87.9	.202	.331 E-0	.566 E-1	28.5	-.437
	12	.255 E-0	.209 E-1	82.0	.103	.770 E-0	.225 E-01	359.6	-.120
	17	.281 E-0	.209 E-1	28.1	.567	.117 E+1	.265 E-0	76.9	.622
	23	.333 E-0	.227 E-1	72.4	.217	ND	ND	ND	ND
	28	.989 E-0	.168 E-1	29.7	.624	ND	ND	ND	ND
	34	.157 E+1	.269 E-1	29.9	29.2	ND	ND	ND	ND
	39	.195 E+1	.218 E-1	84.9	.670	ND	ND	ND	ND

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
32	0	.670 E-1	.174 E-2	271.7	-.176	.684 E-1	.161 E-2	271.7	-.186
	1	.781 E-1	.190 E-2	278.5	-.676	.821 E-1	.166 E-1	30.3	-.612
	6	.549 E-1	.162 E-2	273.4	-.332	.312 E-1	.107 E-1	281.2	-.208
	12	.579 E-1	.193 E-2	85.8	36.0	.559 E-1	.139 E-1	66.8	.979
	17	.710 E-1	.204 E-2	84.9	85.2	.165 E-0	.401 E-2	69.5	.899
	23	.976 E-1	.276 E-2	83.3	35.4	ND	ND	ND	ND
	28	.869 E-1	.235 E-2	89.8	.021	ND	ND	ND	ND
	34	.134 E-0	.278 E-2	25.4	-.943	ND	ND	ND	ND
	39	.102 E-0	.210 E-2	32.8	.628	.847 E-0	.500 E-2	281.7	-.929

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
34	0	.405 E-3	.176 E-3	341.2	-.237	.443 E-3	.183 E-3	339.8	-.284
	1	.475 E-3	.154 E-3	346	-.259	.726 E-3	.195 E-3	353.5	-.198
	6	.397 E-3	.160 E-3	346.3	-.212	.434 E-3	.104 E-3	1.65	.095
	12	.337 E-3	.212 E-3	341.8	-.131	.350 E-3	.208 E-3	31.4	.238
	17	.354 E-3	.256 E-3	336.3	-.165	.420 E-3	.304 E-3	82.5	.068
	23	.381 E-3	.240 E-3	338.1	-.203	.105 E-2	.344 E-3	293.8	.391
	28	.419 E-3	.193 E-3	338.6	-.261	.770 E-3	.290 E-3	318.1	-.451
	34	.504 E-3	.180 E-3	341.9	-.302	.929 E-3	.344 E-3	331.8	-.396
	39	.989 E-3	.167 E-3	349.1	-.284	.715 E-3	.221 E-3	341.0	-.358

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
37	0	.237 E-3	.115 E-3	341.2	-.220	.262 E-3	.119 E-3	338.2	-.268
	1	.291 E-3	.125 E-3	343.1	-.236	.505 E-3	.149 E-3	341.2	-.271
	6	.231 E-3	.106 E-3	344.1	-.205	.249 E-3	.743 E-4	358.5	-.033
	12	.190 E-3	.116 E-3	340.7	-.152	.173 E-3	.116 E-3	30.9	.174
	17	.201 E-3	.124 E-3	336.1	-.178	.218 E-3	.161 E-3	291.2	-.123
	23	.218 E-3	.134 E-3	331.0	-.208	.499 E-3	.216 E-3	300.2	.351
	28	.295 E-3	.125 E-3	338.0	-.233	.439 E-3	.209 E-3	321.4	-.347
	34	.310 E-3	.141 E-3	339.3	-.251	.619 E-3	.434 E-3	325.9	-.268
	39	.300 E-3	.135 E-3	340.6	-.295	.488 E-3	.217 E-3	334.0	-.312

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION V

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
38	0	362 E-1	305 E-3	271.8	-.217	.387 E-1	.317 E-3	271.8	-.329
	1	.1069 E+1	.829 E-3	272.8	-.922	ND			
	6	.424 E-1	.319 E-3	271.1	-.636	.643 E-1	.379 E-3	290.0	-.911
	12	.957 E-2	.193 E-3	274.3	-.470	.435 E-2	.160 E-3	286.1	-.808
	17	.955 E-2	.270 E-3	272.6	-.539	.403 E-2	.154 E-3	274.6	-.369
	23	.963 E-2	.297 E-3	272.2	-.507	.426 E-2	.205 E-3	290.8	-.563
	28	.314 E-1	.294 E-3	271.4	-.677	.362 E-1	.358 E-3	274.3	-.933
	34	.1291 E+1	.867 E-3	558.7	.647	ND			
	39	.1161 E+1	.845 E-3	271.0	-.560	ND			

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
41	0	.135 E-1	.590 E-3	215.8	-.421	.146 E-1	.598 E-3	216.0	-.442
	1	.796 E-1	.781 E-3	218.9	-.843	ND			
	6	.152 E-1	.592 E-3	218.2	-.569	.224 E-1	.582 E-3	293.7	-.912
	12	.499 E-2	.513 E-3	211.8	-.353	.270 E-2	.436 E-3	289.5	-.550
	17	.499 E-2	.521 E-3	215.8	-.269	.259 E-2	.981 E-3	271.9	-.231
	23	.500 E-2	.530 E-3	213.9	-.162	.270 E-2	.684 E-3	281.9	-.217
	28	.122 E-1	.589 E-3	213.5	-.283	.133 E-1	.659 E-3	278.1	-.536
	34	.803 E-1	.794 E-3	213.5	-.618	ND		ND	
	39	.796 E-1	.787 E-3	215.7	-.704	ND		ND	

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
42	0	.111 E-1	.183 E-3	273.1	-.390	.120 E-1	.199 E-3	273.2	-.398
	1	.474 E-1	.293 E-3	274.7	-.722	ND			
	6	.123 E-1	.187 E-3	275.2	-.597	.164 E-1	.215 E-3	289.6	-.931
	12	.460 E-2	.136 E-3	275.8	-.493	.268 E-2	.123 E-3	285.9	-.759
	17	.460 E-2	.138 E-3	274.1	-.369	.254 E-2	.113 E-3	276.3	-.442
	23	.462 E-2	.142 E-3	272.0	-.190	.263 E-2	.167 E-3	85.1	.304
	28	.102 E-1	.181 E-3	271.0	-.121	.115 E-1	.240 E-3	271.1	-.928
	34	.492 E-1	.302 E-3	89.9	.0112	ND			
	39	.492 E-1	.297 E-3	272.1	-.426	ND			

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
45	0	.139 E-3	.611 E-4	345.2	-.205	.152 E-3	.632 E-4	352.9	-.248
	1	.129 E-3	.689 E-4	342.9	-.269	.347 E-3	.925 E-4	344.5	-.343
	6	.140 E-3	.567 E-4	347.4	-.195	.177 E-3	.426 E-4	358.9	.0300
	12	.112 E-3	.625 E-4	352.8	-.0237	.135 E-3	.595 E-4	29.1	.330
	17	.114 E-3	.671 E-4	346.4	-.106	.105 E-3	.104 E-3	274.6	-.0011
	23	.119 E-3	.728 E-4	342.7	-.140	.236 E-3	.119 E-3	302.0	-.300
	28	.140 E-3	.661 E-4	342.7	-.214	.225 E-3	.110 E-3	326.3	-.325
	34	.184 E-3	.795 E-4	339.4	-.274	.347 E-3	.192 E-3	325.3	-.269
	39	.181 E-3	.743 E-4	341.0	-.273	.298 E-3	.124 E-3	332.5	-.347

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
49	0	.289 E-3	.111 E-3	335.5	-.351	.311 E-3	.172 E-3	334.7	-.380
	1	.297 E-3	.677 E-4	342.2	-.307	.390 E-3	.407 E-4	355	.0220
	6	.271 E-3	.105 E-3	340.3	-.298	.279 E-3	.920 E-4	4.26	.182
	12	.298 E-3	.171 E-3	308.9	-.267	.544 E-3	.186 E-3	14.8	.274
	17	.328 E-3	.166 E-3	309.0	-.321	.680 E-3	.201 E-3	280.9	-.233
	23	.369 E-3	.163 E-3	309.1	-.381	.158 E-2	.211 E-3	297.1	-.692
	28	.313 E-3	.116 E-3	331.2	-.400	.647 E-3	.131 E-3	321.7	-.653
	34	.324 E-3	.732 E-4	343.9	-.397	.537 E-3	.842 E-4	342.9	-.515
	39	.310 E-3	.706 E-4	345.9	-.359	.392 E-3	.567 E-4	349.2	-.382

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
52	0	.124 E-1	.295 E-3	272.2	-.241	.133 E-1	.305 E-3	272.4	-.266
	1	.563 E-1	.414 E-3	274.0	-.826	ND			
	6	.137 E-1	.296 E-3	274.4	-.456	.193 E-1	.300 E-3	289.1	-.922
	12	.509 E-2	.242 E-3	275.6	-.252	.175 E-2	.203 E-3	286.7	-.678
	17	.498 E-2	.247 E-3	273.2	-.233	.210 E-2	.218 E-3	275.7	-.309
	23	.498 E-2	.253 E-3	271.1	-.213	.227 E-2	.303 E-3	53.6	.283
	28	.112 E-1	.295 E-3	270.9	-.0068	.121 E-1	.322 E-3	276.0	-.196
	34	.573 E-1	.425 E-3	89.2	.166	ND			
	39	.564 E-1	.419 E-3	271.4	-.264	ND			

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION V

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
54	0	.213 E-1	.231 E-2	270.0	-.2500	.226 E-1	.242 E-2	278.7	-.3167
	1	.362 E-1	.201 E-2	271.3	-.2500	.207 E-1	.717 E-3	295.6	-.8917
	6	.175 E-1	.175 E-2	270.0	-.2500	.719 E-2	.995 E-3	285.0	-.8667
	12	.107 E-1	.153 E-2	270.0	-.2500	.511 E-2	.399 E-3	282.1	-.7500
	17	.125 E-1	.198 E-2	270.0	-.2500	.148 E-2	.991 E-2	270.0	-.2115
	23	.155 E-1	.283 E-2	270.0	-.2500	.338 E-2	ND	ND	
	28	.271 E-1	.317 E-2	274.7	-.2500	.181 E-2	ND	ND	
	34	.995 E-1	.389 E-2	269.5	-.2500	.142 E-2	ND	ND	
	39	.574 E-1	.279 E-2	270.1	-.2500	.228 E-2	ND	ND	

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
56	0	.846 E-4	.261 E-4	301.4	-.1484	.755 E-4	.290 E-4	305.2	-.2511
	1	.128 E-3	.416 E-4	311.7	-.1505	.305 E-3	.875 E-4	331.2	-.4491
	6	.818 E-4	.273 E-4	304.9	-.1475	.980 E-4	.420 E-4	312.6	-.2241
	12	.618 E-4	.185 E-4	285.1	-.1306	.771 E-4	.227 E-4	161.3	-.1481
	17	.680 E-4	.177 E-4	285.1	-.1354	.895 E-4	.142 E-4	271.0	-.0379
	23	.763 E-4	.176 E-4	286.4	-.1398	.184 E-3	.337 E-4	255.3	-.4148
	28	.889 E-4	.250 E-4	298.9	-.1482	.172 E-3	.517 E-4	299.0	-.1468
	34	.137 E-3	.445 E-4	306.6	-.1495	.331 E-3	.142 E-3	300.0	-.3523
	39	.132 E-3	.427 E-4	308.7	-.1503	.273 E-3	.914 E-4	311.3	-.1495

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
60	0	.160 E-3	.593 E-4	309.1	-.1450	.178 E-3	.622 E-4	312.2	-.1480
	1	.155 E-3	.473 E-4	324.4	-.1439	.268 E-3	.371 E-4	357.8	-.0875
	6	.140 E-3	.646 E-4	312.8	-.1367	.168 E-3	.687 E-4	22.5	.3110
	12	.212 E-3	.607 E-4	282.4	-.1269	.451 E-3	.579 E-4	172.7	-.5681
	17	.231 E-3	.576 E-4	285.9	-.1318	.521 E-3	.564 E-4	174.1	-.1881
	23	.258 E-3	.543 E-4	289.2	-.1474	.114 E-2	.623 E-4	222.5	-.8819
	28	.183 E-3	.547 E-4	306.9	-.1524	.453 E-3	.450 E-4	310.3	-.1816
	34	.178 E-3	.431 E-4	328.0	-.1569	.360 E-3	.443 E-4	332.0	-.1715
	39	.166 E-3	.449 E-4	320.5	-.1515	.246 E-3	.367 E-4	329.2	-.1591

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
63	0	.233 E-3	.114 E-3	341.8	-.1339	.256 E-3	.116 E-3	314.7	-.1314
	1	.226 E-3	.782 E-4	340.8	-.1318	.334 E-3	.444 E-4	1.19	.0499
	6	.205 E-3	.119 E-3	318.8	-.1268	.249 E-3	.101 E-3	23.9	.3127
	12	.334 E-3	.126 E-3	281.1	-.1188	.819 E-3	.121 E-3	23.0	.5271
	17	.363 E-3	.123 E-3	284.9	-.1273	.968 E-3	.127 E-3	372.9	-.1221
	23	.406 E-3	.118 E-3	288.6	-.1369	.225 E-2	.131 E-3	291.7	-.8021
	28	.267 E-3	.1103 E-3	308.3	-.1410	.659 E-3	.904 E-4	311.1	-.1756
	34	.247 E-3	.758 E-4	333.4	-.1499	.453 E-3	.591 E-4	338.9	-.1679
	39	.233 E-3	.770 E-4	336.4	-.1493	.312 E-3	.505 E-4	341.5	-.1493

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
64	0	.111 E-1	.353 E-3	272.9	-.2537	.170 E-1	.361 E-3	272.7	-.2556
	1	.482 E-1	.459 E-3	274.4	-.1681		N D		
	6	.123 E-1	.355 E-3	274.3	-.1429	.168 E-1	.359 E-3	289.4	-.1903
	12	.458 E-2	.305 E-3	275.3	-.2516	.269 E-2	.267 E-3	286.2	-.1608
	17	.457 E-2	.309 E-3	273.5	-.2514	.251 E-2	.283 E-3	276.0	-.2653
	23	.458 E-2	.316 E-3	271.3	-.0825	.257 E-2	.361 E-3	253.6	-.2455
	28	.101 E-1	.353 E-3	270.4	-.0353	.112 E-1	.414 E-3	116.3	-.1560
	34	.495 E-1	.470 E-3	89.5	-.0835		N D		
	39	.487 E-1	.465 E-3	271.7	-.2912		N D		

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
72	0	.143 E-3	.553 E-4	294.7	-.2258	.156 E-3	.571 E-4	241.5	-.2219
	1	.182 E-3	.614 E-4	292.9	-.2306	.194 E-3	.841 E-4	245.1	-.2353
	6	.143 E-3	.512 E-4	295.9	-.2247	.178 E-3	.776 E-4	257.9	-.2014
	12	.116 E-3	.593 E-4	296.1	-.2137	.132 E-3	.647 E-4	266.4	-.2179
	17	.119 E-3	.631 E-4	294.1	-.2168	.113 E-3	.100 E-3	314.0	-.0689
	23	.125 E-3	.678 E-4	293.2	-.2227	.248 E-3	.114 E-3	304.4	-.1349
	28	.145 E-3	.599 E-4	294.3	-.2268	.233 E-3	.100 E-3	326.4	-.3372
	34	.187 E-3	.711 E-4	293.6	-.2312	.345 E-3	.176 E-3	328.7	-.2927
	39	.184 E-3	.664 E-4	291.1	-.2310	.295 E-3	.113 E-3	334.3	-.3631

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION V

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
76	0	361 E-3	135 E-3	346.8	-.223	381 E-3	139 E-3	345.2	-.253
	1	386 E-3	751 E-4	253.5	-.200	305 E-3	407 E-4	1.33	0747
	6	353 E-3	123 E-3	350.9	-.171	400 E-3	742 E-4	9.60	.251
	12	333 E-3	214 E-3	333.7	-.130	625 E-3	266 E-3	24.1	.327
	17	357 E-3	239 E-3	326.2	-.183	709 E-3	303 E-3	276.9	-.104
	23	394 E-3	236 E-3	320.8	-.245	166 E-2	289 E-3	286.4	-.618
	28	376 E-3	147 E-3	342.3	-.212	683 E-3	173 E-3	325.0	-.372
	34	404 E-3	844 E-4	349.6	-.294	603 E-3	834 E-4	345.1	-.465
	39	395 E-3	803 E-4	351.4	-.254	480 E-3	592 E-4	352.0	-.372

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
91	0	.160 E-3	.739 E-4	318.8	-.364	.177 E-3	.757 E-4	320.2	-.395
	1	.233 E-3	.903 E-4	322.3	-.349	.516 E-3	.163 E-3	339.1	-.432
	6	.159 E-3	.727 E-4	322.9	-.341	.199 E-3	.791 E-4	338.7	-.401
	12	.112 E-3	.740 E-4	319.1	-.209	.130 E-3	.803 E-4	320.0	-.231
	17	.120 E-3	.748 E-4	308.7	-.225	.133 E-3	.826 E-4	324.1	-.358
	23	.181 E-3	.759 E-4	309.2	-.250	.127 E-3	.966 E-4	286.9	-.289
	28	.163 E-3	.775 E-4	314.7	-.366	.217 E-3	.106 E-3	303.0	-.414
	34	.244 E-3	.960 E-4	316.8	-.434	.539 E-3	.219 E-3	309.2	-.598
	39	.238 E-3	.930 E-4	319.2	-.433	.458 E-3	.162 E-3	316.1	-.478

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
102	0	297 E-1	.112 E-2	68.0	.865	316 E-1	.115 E-2	68.1	.869
	1	.689 E-1	.164 E-2	60.0	.939	.167 E+1	.480 E-2	69.8	.990
	6	357 E-8	.114 E-2	68.3	.881	.992 E-1	.141 E-2	75.3	.892
	12	293 E-1	.797 E-3	78.6	.719	.940 E-1	.741 E-3	87.3	.941
	17	.217 E-1	.802 E-3	78.4	.702	.226 E-1	.583 E-3	88.6	.948
	23	.189 E-1	.816 E-3	78.3	.624	.104 E-1	.621 E-3	80.0	.582
	28	.247 E-1	.110 E-2	67.8	.895	.851 E-2	.157 E-2	62.8	.613
	34	.530 E-1	.165 E-2	55.8	.931	.379 E-0	.318 E-2	59.3	.917
	39	.590 E-1	.164 E-2	51.8	.935	.438 E-0	.337 E-2	57.7	.985

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
103	0	.987 E-1	.220 E-2	85.9	.746	.101 E-0	.215 E-2	85.8	.872
	1	.129 E-0	.244 E-2	72.5	.299	.109 E-0	.148 E-2	72.2	.635
	6	.784 E-1	.216 E-2	81.8	.218	.371 E-1	.966 E-2	77.2	.177
	12	.755 E-1	.250 E-2	79.5	.685	.551 E-1	.117 E-1	64.6	.553
	17	.962 E-1	.261 E-2	73.9	.771	.211 E-0	.490 E-2	61.3	.937
	23	.141 E-0	.319 E-2	75.3	.847	ND			
	28	.133 E-0	.268 E-2	82.7	.651	ND			
	34	.294 E-0	.309 E-2	88.1	.280				
	39	.171 E-0	.285 E-2	79.2	.027	.207 E+1	.529 E-2	72.5	-.110

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
109	0	.107 E-3	.597 E-4	322.9	-.274	.120 E-3	.609 E-4	322.9	-.316
	1	.160 E-3	.736 E-4	322.6	-.355	.367 E-3	.114 E-3	342	-.436
	6	.107 E-3	.577 E-4	326.5	-.278	.143 E-3	.513 E-4	350.2	-.177
	12	.726 E-4	.569 E-4	322.3	-.117	.940 E-4	.449 E-4	325.5	-.237
	17	.772 E-4	.581 E-4	312.5	-.141	.879 E-4	.588 E-4	296.6	-.0240
	23	.848 E-4	.596 E-4	307.9	-.166	.185 E-3	.815 E-4	288.3	-.254
	28	.108 E-3	.621 E-4	317.5	-.270	.191 E-3	.974 E-4	316.4	-.300
	34	.166 E-3	.814 E-4	317.5	-.342	.382 E-3	.201 E-3	302.0	-.291
	39	.163 E-3	.775 E-4	320.2	-.349	.922 E-3	.134 E-3	315.6	-.411

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
113	0	.143 E-3	.487 E-4	320.2	-.478	.161 E-3	.519 E-4	320.6	-.506
	1	.142 E-3	.426 E-4	322.1	-.465	.259 E-3	.381 E-4	346.6	-.132
	6	.125 E-3	.533 E-4	310.5	-.394	.149 E-3	.601 E-4	21.4	9.09
	12	.183 E-3	.462 E-4	291.6	-.281	.365 E-3	.420 E-4	71.9	.611
	17	.200 E-3	.437 E-4	285.0	-.261	.430 E-3	.488 E-4	2.23	-.168
	23	.226 E-3	.411 E-4	290.3	-.249	.258 E-3	.509 E-4	-91.6	-.314
	28	.165 E-3	.445 E-4	306.4	-.552	.417 E-3	.393 E-4	309.8	-.523
	34	.166 E-3	.387 E-4	325.9	-.593	.854 E-3	.470 E-4	303.4	-.705
	39	.154 E-3	.403 E-4	322.5	-.541	.239 E-3	.379 E-4	337.8	-.599

USE FOR DRAWING AND HANDPRINTING — NO TYPEWRITTEN MATERIAL

λ_1, λ_2, β, ρ FOR TOTAL ERRORS — MISSION V

FRAME	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ	POINT	T λ_1	T λ_2	T β	T ρ	W λ_1	W λ_2	W β	W ρ
117	0	.198 E-3	.917 E-4	321.1	-.708	.225 E-3	.835 E-4	321.9	-.479	12	.195 E-3	.994 E-4	291.6	-.218	.309 E-3	.910 E-4	66.7	82.7	28	.219 E-3	.820 E-4	316.9	-.459	.519 E-3	.909 E-4	311.9	-.501
	1	.225 E-3	.639 E-4	351.5	-.429	.377 E-3	.583 E-4	34.1	-.215	17	.217 E-3	.951 E-4	291.5	-.295	.403 E-3	.982 E-4	213.7	-.099	34	.250 E-3	.671 E-4	331.5	-.310	.514 E-3	.102 E-3	330.6	-.609
	6	.183 E-3	.809 E-4	321.1	-.357	.209 E-3	.709 E-4	2.94	-.149	23	.249 E-3	.928 E-4	295.2	-.348	.973 E-3	.113 E-3	291.8	-.652	39	.237 E-3	.654 E-4	334.0	-.476	.565 E-3	.714 E-4	338.2	-.531
130	0	.837 E-3	.285 E-3	298.5	-.932	.893 E-3	.315 E-3	302.1	-.643	12	.875 E-3	.231 E-3	283.6	-.310	.159 E-2	.253 E-3	86.0	.149	28	.919 E-3	.260 E-3	291.4	-.482	.185 E-2	.250 E-3	294.1	-.708
	1	.915 E-3	.374 E-3	313.3	-.719	.164 E-2	.824 E-3	316.5	-.158	17	.941 E-3	.223 E-3	285.2	-.369	.153 E-2	.212 E-3	216.8	-.262	34	.105 E-2	.329 E-3	308.6	-.517	.223 E-2	.944 E-3	310.2	-.662
	6	.769 E-3	.311 E-3	299.7	-.373	.855 E-3	.557 E-3	53.2	.203	23	.104 E-2	.215 E-3	286.7	-.932	.295 E-2	.239 E-3	286.6	-.262	39	.984 E-3	.344 E-3	311.2	-.476	.165 E-2	.487 E-3	318.3	-.541
168	0	.417 E-3	.243 E-3	320.0	-.260	.475 E-3	.298 E-3	324.3	-.369	12	.312 E-3	.234 E-3	291.9	-.125	.278 E-3	.176 E-3	37.2	.218	28	.440 E-3	.253 E-3	314.2	-.210	.898 E-3	.356 E-3	300.5	-.387
	1	.377 E-3	.270 E-3	321.1	-.320	.107 E-2	.350 E-3	343.0	-.312	17	.331 E-3	.239 E-3	283.3	-.149	.380 E-3	.235 E-3	31.3	.019	34	.619 E-3	.298 E-3	320.1	-.395	.158 E-2	.648 E-3	306.1	-.405
	6	.403 E-3	.283 E-3	326.1	-.298	.435 E-3	.182 E-3	355.9	-.064	23	.375 E-3	.245 E-3	288.7	-.175	.923 E-3	.312 E-3	284.0	-.257	39	.590 E-3	.285 E-3	321.5	-.335	.113 E-2	.440 E-3	321.4	-.429
170	0	.109 E-3	.398 E-4	310.5	-.452	.125 E-3	.422 E-4	313.6	-.484	12	.763 E-4	.341 E-4	294.3	-.296	.884 E-4	.357 E-4	57.3	.379	28	.114 E-3	.406 E-4	307.9	-.446	.224 E-3	.689 E-4	303.2	-.497
	1	.161 E-3	.548 E-4	319.6	-.487	.369 E-3	.100 E-3	336.2	-.459	17	.844 E-4	.333 E-4	292.9	-.335	.105 E-3	.305 E-4	274.0	-.092	34	.173 E-3	.593 E-4	314.4	-.489	.411 E-3	.171 E-3	302.9	-.401
	6	.105 E-3	.401 E-4	314.6	-.442	.129 E-3	.476 E-4	347.7	-.212	23	.952 E-4	.333 E-4	293.5	-.372	.235 E-3	.513 E-4	298.1	-.442	39	.166 E-3	.569 E-4	314.6	-.490	.335 E-3	.111 E-3	319.0	-.500
174	0	.167 E-3	.691 E-4	317.3	-.442	.188 E-3	.708 E-4	319.2	-.450	12	.185 E-3	.787 E-4	285.6	-.222	.349 E-3	.717 E-4	69.3	.501	28	.187 E-3	.669 E-4	313.0	-.472	.458 E-3	.645 E-4	311.5	-.751
	1	.183 E-3	.523 E-4	337.8	-.424	.322 E-3	.448 E-4	356.4	-.142	17	.205 E-3	.754 E-4	288.9	-.305	.418 E-3	.748 E-4	273.2	-.106	34	.206 E-3	.521 E-4	331.4	-.529	.424 E-3	.683 E-4	331.9	-.656
	6	.161 E-3	.711 E-4	323.5	-.346	.185 E-3	.652 E-4	4.2	.251	23	.233 E-3	.721 E-4	291.9	-.394	.962 E-3	.850 E-4	291.4	-.782	39	.194 E-3	.522 E-4	324.0	-.485	.299 E-3	.503 E-4	339.6	-.552
	0									12									28								
	1									17									34								
	6									23									39								

Appendix J

Sample Sensitivity Matrices

Introduction:

Sample sensitivity matrices $[S_T]$ and $[S_W]$ are given, where

$$[S]_{T,W} = \begin{bmatrix} \frac{\partial P_{0\mu}}{\partial x} & \frac{\partial P_{0\mu}}{\partial y} & \frac{\partial P_{0\mu}}{\partial z} & \frac{\partial P_{0\mu}}{\partial \dot{x}} & \frac{\partial P_{0\mu}}{\partial \dot{y}} & \frac{\partial P_{0\mu}}{\partial \dot{z}} & \frac{\partial P_{0\mu}}{\partial \Phi} & \frac{\partial P_{0\mu}}{\partial \Theta} & \frac{\partial P_{0\mu}}{\partial \Psi} & \frac{\partial P_{0\mu}}{\partial t} & \frac{\partial P_{0\mu}}{\partial R_m} \\ \frac{\partial P_{0\lambda}}{\partial x} & \frac{\partial P_{0\lambda}}{\partial y} & \frac{\partial P_{0\lambda}}{\partial z} & \frac{\partial P_{0\lambda}}{\partial \dot{x}} & \frac{\partial P_{0\lambda}}{\partial \dot{y}} & \frac{\partial P_{0\lambda}}{\partial \dot{z}} & \frac{\partial P_{0\lambda}}{\partial \Phi} & \frac{\partial P_{0\lambda}}{\partial \Theta} & \frac{\partial P_{0\lambda}}{\partial \Psi} & \frac{\partial P_{0\lambda}}{\partial t} & \frac{\partial P_{0\lambda}}{\partial R_m} \\ \frac{\partial P_{1\mu}}{\partial x} & \cdots & & & & & & & & & \\ \vdots & \leftarrow \text{POINT SEQUENCE } 0,1,6,12,17,23,28,34,39 & & & & & & & & & \\ \frac{\partial P_{39\lambda}}{\partial x} & \cdots & & & & & & & & & \frac{\partial P_{39\lambda}}{\partial R_m} \end{bmatrix}_{T,W}$$

as discussed in Section 2.0. The units are degrees on the moon surface for the P_μ and P_λ photo (latitude and longitude) parameters, and km, sec, and degrees of spacecraft attitude for parameters in the denominators of the elements of the matrix.

Sample $[S_T]$ and $[S_W]$ for Mission III, Frame 73:

$$[S_T] = \begin{bmatrix}
-.1763E\text{-}01 & -.4670E\text{-}01 & .2133E\text{-}01 & -.1060E+01 & -.2815E+01 & .1316E+01 & .9847E\text{-}01 & .9442E\text{-}02 & .3291E\text{-}01 & -.2775E\text{-}01 & -.4324E\text{-}01 \\
+.2279E\text{-}01 & -.2775E\text{-}01 & -.8651E\text{-}02 & .1369E+01 & -.1672E+01 & -.5199E\text{-}00 & .1936E\text{-}01 & .6458E\text{-}01 & .1350E\text{-}01 & .5684E\text{-}01 & -.1619E\text{-}01 \\
-.2724E\text{-}01 & -.6780E\text{-}01 & .1785E\text{-}01 & -.1639E+01 & -.9117E+01 & .1071E+01 & .1840E\text{-}00 & .3372E\text{-}01 & .4967E\text{-}01 & -.3035E\text{-}01 & -.8730E\text{-}01 \\
.1729E\text{-}01 & -.3997E\text{-}01 & -.1114E\text{-}01 & .1034E+01 & -.2425E+01 & -.6696E\text{-}00 & .5874E\text{-}01 & .9721E\text{-}01 & .3808E\text{-}01 & .5547E\text{-}01 & -.3015E\text{-}01 \\
-.1773E\text{-}01 & -.4715E\text{-}01 & .2182E\text{-}01 & -.1085E+01 & -.2843E+01 & .1309E+01 & .1003E+00 & .1071E\text{-}01 & .2924E\text{-}01 & -.2760E\text{-}01 & -.4372E\text{-}01 \\
.2151E\text{-}01 & -.3045E\text{-}01 & -.9329E\text{-}02 & .1292E+01 & -.1836E+01 & -.5608E\text{-}00 & .2404E\text{-}01 & .6713E\text{-}01 & .1434E\text{-}01 & .5655E\text{-}01 & -.1934E\text{-}01 \\
-.1151E\text{-}01 & -.3416E\text{-}01 & .2476E\text{-}01 & -.6910E\text{-}00 & -.2054E+01 & .1486E+01 & .6399E\text{-}01 & .2479E\text{-}02 & .2182E\text{-}01 & -.2581E\text{-}01 & -.2862E\text{-}01 \\
.2428E\text{-}01 & -.2451E\text{-}01 & -.7999E\text{-}02 & .1458E+01 & -.1474E+01 & -.4809E\text{-}00 & .9904E\text{-}02 & .5130E\text{-}1 & .8475E\text{-}3 & .5725E\text{-}1 & -.1247E\text{-}1 \\
-.1188E\text{-}1 & -.3480E\text{-}1 & .2461E\text{-}1 & -.7136 & -2.093 & 1.476 & .06521 & .002780 & .02445 & -.02601 & -.02940 \\
.02501 & -.02304 & -.007594 & 1.502 & -1.386 & -.4565 & .008443 & .05082 & .001290 & .05743 & -.01073 \\
-.01233 & -.03559 & .02443 & -.7408 & -2.140 & 1.466 & .06675 & .003068 & .02773 & -.02624 & -.03034 \\
.02589 & -.02127 & -.007111 & 1.555 & -1.279 & -.4274 & .006580 & .05045 & .001617 & .05766 & -.008633 \\
-.01754 & -.04629 & .02203 & -1.055 & -2.789 & 1.322 & .09681 & .008307 & .03642 & -.02789 & -.04281 \\
.02403 & -.02518 & -.008004 & 1.443 & -1.517 & -.4810 & .01500 & .06201 & .01243 & .05715 & -.01318 \\
-.02907 & -.07075 & .01742 & -1.751 & -4.297 & 1.046 & .1981 & .03051 & .06851 & -.03170 & -.07085 \\
.01990 & -.03417 & -.009728 & 1.194 & -2.072 & -.5844 & .04649 & .09088 & .03980 & .05597 & -.02345 \\
-.02821 & -.06938 & .01762 & -1.699 & -4.214 & 1.057 & .1915 & .03207 & .05970 & -.03107 & -.06920 \\
.01868 & -.03681 & -.01037 & 1.120 & -2.233 & -.6228 & .05222 & .09350 & .03929 & .05572 & -.02657
\end{bmatrix}$$

Appendix J, cont'd

Sample $[S_T]$ and $[S_W]$ for Mission III, Frame 73; cont'd

$[S_W] =$

-.01763	-.04670	.02193	-1.060	-2.815	1.316	.09847	.009443	.03291	-.02775	-.04324
.02279	-.02775	-.008651	1.369	-1.672	-.5199	.01937	.06458	.01350	.05894	-.01619
-.09845	-.2205	-.007613	-5.689	-16.47	-.5038	1.780	.9227	.09411	-.02490	-.2307
-.04845	-.1999	-.03935	-3.247	-15.00	-2.407	1.515	1.050	.1790	.05829	-.2032
-.01496	-.04272	.02270	-.8972	-2.579	1.362	.08866	.01126	.0008999	-.02574	-.03825
.01457	-.04586	-.01342	.8762	-2.759	-.8078	.04381	.08797	.003496	.05567	-.03703
-.005192	-.02172	.02795	-.3112	-1.304	1.677	.04414	-.004761	.008917	-.02391	-.01389
.02206	-.02891	-.009449	1.325	-1.738	-.5687	.008159	.04448	-.01291	.05687	-.01777
-.007207	-.02544	.02696	-.4327	-1.527	1.618	.04750	.0001178	.02002	-.02460	-.01836
.02645	-.02004	-.006866	1.588	-1.204	-.4127	.003668	.04117	-.007423	.05780	-.007226
-.009866	-.03011	.02578	-.5936	-1.808	1.547	.05366	.003149	.03729	-.02587	-.02402
.03208	-.009231	-.003871	1.927	-.5550	-.2322	-.005636	.04425	-.008675	.05959	.005692
-.02074	-.05122	.02108	-1.250	-3.087	1.265	.1120	.003699	.06911	-.03018	-.04887
.03104	-.01135	-.004532	1.865	-.6819	-.2720	-.008661	.06122	.005795	.05943	.003167
NOMINAL OFF THE MOON →										
NOMINAL OFF THE MOON →										
-.1235	-.2689	-.003598	-8.142	-20.09	-.2172	2.822	.6418	.8108	-.06980	-.2864
-.01721	-.1131	-.01843	-1.318	-8.385	-1.108	1.053	.4361	.3985	.04220	-.1092